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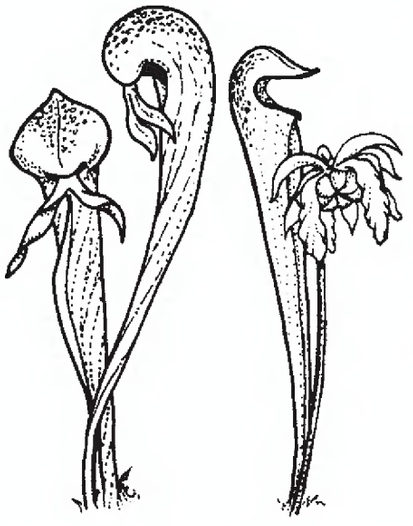

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Front Cover: *Pinguicula involuta* growing on an east-facing vertical cliff dripping with water at 3870 m on the Andes Highlands near Cusco, southern Peru. Photo by Fernando Rivadavia. Article on page 122.

Back Cover: *Drosera murfetii* growing at the type location, Hartz Mountains, Tasmania. Photo by Richard Nunn. Article on page 128.

Carnivorous Plant Newsletter is dedicated to spreading knowledge and news related to carnivorous plants. Reader contributions are essential for this mission to be successful. Do not hesitate to contact the editors with information about your plants, conservation projects, field trips, or noteworthy events. Advertisers should contact the editors. Views expressed in this publication are those of the authors, not the editorial staff.

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International Carnivorous Plant Society, Inc.
2121 N. California Blvd., Suite 290
Walnut Creek, CA 94596-7351, USA
icps@carnivorousplants.org

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ICPS Conference 2020

May 22–24, 2020

Himeji, Japan

The 13th ICPS conference will be held in Himeji City, Hyogo Prefecture from Friday, May 22 to Sunday, May 24, 2020. The city is renowned for Himeji Castle, a world heritage site that proudly represents the beauty of Japanese castles. Also, there is the Hyogo Prefectural Flower Center in the vicinity (about a 45-minute drive), which has a world-class carnivorous plant collection. Himeji is accessible from Kansai International Airport or from Tokyo by "Shinkansen" bullet train.

The 3-day conference will be held at a conference facility known as "Biz Space," located a 7-minute walk from Himeji Station and within walking distance of several major hotels. The lectures will cover a wide range of topics such as scientific/academic research, horticulture, conservation, etc.

We are planning to bring in English-Japanese interpreters so that more Japanese members can participate in the conference.

Plant displays and sales booths, including a Japanese top-class CP nursery, will be available in the same building during the conference.

The conference banquet is to be held on May 23 at a near-by restaurant, where you can enjoy a good mix of Japanese and Western cuisines together with an impressive nighttime view of Himeji Castle.

On May 25, we are planning a special day trip to the Hyogo Prefectural Flower Center. We will be guided through the amazing collections of *Nepenthes*, *Sarracenia*, and other carnivorous plants in the spectacular carnivorous plant greenhouse as well as the backyard. You will be meeting the giant *N. clipeata* and *N. pervillei* that were introduced in the 2018 ICPS conference.

On May 26, we will enjoy an excursion to see the local habitats of *Drosera rotundifolia, D. tokaiensis*, and *D. peltata* (syn. *lunata*), and maybe a few *Utricularia*, and then a trip to Tokyo for an overnight stay. On the following day (May 27), we will visit the habitat of *Pinguicula ramosa*, the Japanese endemic butterwort, on Mt. Nyoho, Nikko City. Note that it might be too early to see the flowers. Details including dates and locations will be finalized shortly.

The ICPS Conference 2020 will be hosted by the three Japanese CP societies: The Japanese Carnivorous Plant Society (JCPS), The Carnivorous Plant Exploration Society (CPES), and The Tokai Carnivorous Plant Society (TCPS). These three societies mainly cover the Kanto, Kansai, and Tokai regions, respectively, and have been collaborating with each other and contributing to the prevalence and awareness of carnivorous plants in Japan.

For more information on the conference, please feel free to contact Koji Kondo, a member of CPES, JCPS, and ICPS, by email at kokonchip@gmail.com until the official conference web page becomes available.

We are looking forward to seeing you in Himeji in May 2020!

Himeji Castle (left) and Hyogo Prefectural Flower Center (right).

In memory of a mentor—Don Schnell (1936–2019)

Barry Rice • Center for Plant Diversity • UC Davis • Davis • California • USA • barry@carnivorousplants.org

A long, long, long time ago, I was a fresh graduate from college, marking time for the summer before I started graduate school. On a trip to a grocery store, I encountered a display of Venus flytraps. Smitten, I decided to try to grow them. This was not my first try. Oh no, I had tried as a child repeatedly, but killed them every time. But now, with a physics degree under my belt, I was a scientist. I would research and learn before I tried to grow the plants.

My local library had several books on carnivorous plants, but I quickly realized that they were essentially junk. Only two seemed to have merit. One—by Adrian Slack—was lovely but seemed to be pitched to a European audience. The slim book by Don Schnell, however, was just what I wanted.

And that book changed my life. It introduced me to a whole set of fascinating plants, it described how they could be grown, and most importantly, it emphasized the plants in the wild. It is probably true that I've read that book more times than any other. Indeed, to write this memorial, I pulled the book off my shelf—it's pretty beaten up—and am paging through it. As I do, I'm overwhelmed with familiarity. I've studied every sentence, every word. This book was my key to a new universe. Through modern eyes, it might seem a bit quaint—but I'm so biased I cannot see from that vantage point.

Over the years, I began a casual correspondence with Don. He was thoughtful but opinionated; tolerant of my errors, but quite ready to point them out! We discussed field observations and thoughts on (mostly) *Sarracenia*, but also *Utricularia*—which he freely admitted was inadequately treated in his book.

Then came his retreat from the International Carnivorous Plant Society, and of course Carnivorous Plant Newsletter, both of which he cofounded. I was selected as one of the next generation of enthusiasts to take over. Don was very gracious in giving us free reign over the journal, but also sent me a letter with several pages of very stern advice. I felt I was asking for his daughter's hand in marriage—and he wasn't completely sure I was qualified!

Don's legacy in botany will probably be most strongly remembered in his contributions to *Sarracenia*. He did much of the work that set the landscape for our current interpretation of the genus—even if you do not agree with all his perspectives, you cannot deny his contributions. (I continue, at every turn, to encourage the adoption of "Schnell's pitcher plant" as the common name for *Sarracenia rubra* subsp. *gulfensis*.) His second book was, once again, vastly important in summarizing our knowledge of plants in the US and Canada. And his third "book"—Carnivorous Plant Newsletter—is still in publication.

Hearing, just yesterday, that Don passed on—well, was a punch to the gut. I'm sure many will write more succinctly about his various publications and contributions to botanical history. But for me, he is most important in the influence he had in redirecting the trajectory of my life.

For a detailed discussion about Don Schnell's contribution to ICPS and CPN, see the 2011 article by Peter D'Amato, The Savage Garden: "The creation and early evolution of CPN" (https://legacy.carnivorousplants.org/cpn/articles/CPNv40n2p56_59.pdf).

Hybrids of world populations of *Aldrovanda vesiculosa*

Yoshiaki Katagiri • Niigata-City • Japan • katagirikashiten@kit.hi-ho.ne.jp

Keywords: Aquatic carnivorous plant, Droseraceae, hybrid traits, cultivation description.

Introduction

Aldrovanda vesiculosa L. (waterwheel plant, Droseraceae) is a rare and remarkable aquatic carnivorous plant with snapping traps living naturally on four continents of the Old World and introduced to North America (Breckpot 1997; Cross 2012; Fleischmann *et al*. 2018). Although *Aldrovanda* covers a huge territory within several climatic zones (temperate to tropical), it is highly scattered. A recent world-wide survey found only 50 sites, with the center of its distribution in Ukraine and Poland (Cross 2012; Adamec 2018). *Aldrovanda* is a monotypic genus without any subspecies, but its distant world populations usually differ in some physiological traits (turion formation, red coloration). However, in spite of these striking physical differences, the genetic differences between world populations (accessions) are surprisingly minimal (Adamec & Tichý 1997; Maldonado San Martín *et al*. 2003; Hoshi *et al*. 2006; Elansary *et al*. 2010; Cross 2012; Adamec 2018). Although the flowers are opened for only a few hours (Adamec & Tichý 1997; Cross 2012; Adamec 2018), under favorable conditions in all climatic zones, autogamous *Aldrovanda* can flower, self-pollinate, and set seed (Cross *et al*. 2016).

In 2007, after having a long-term experience in growing various *Aldrovanda* populations in my collection, I tried first to hybridize some strains of *Aldrovanda* plants under the following scheme: pollen acceptors (♀) were green-colored plants, while pollen donors (♂) were red-colored plants. In 2009, I could confirm some red-colored plants among the hybrids so that it has turned out that the hybridization has been successful. Afterwards, I continued to hybridize various world populations (also with both red parents) and have obtained many hybrids (or assumed hybrids).

Methods

I have been cultivating 15 strains of *Aldrovanda* from four continents for many years. They are grown outdoors in 10- to 15-liter plastic containers with rice straw and brown *Sphagnum* peat moss as substrates. Tropical strains are grown over winter in a heated greenhouse in 1- to 1.5-liter PET bottles with *Sphagnum* peat moss. However, most strains die before spring. Generally, the flowering season of *Aldrovanda* in my collection is from July to September and the best period for pollination is August. Thus, I conducted pollinations in August when each *Aldrovanda* population flowered on the same day. After removing pistils with anthers from a just opened *Aldrovanda* flower (♀) using fine forceps, excised anthers from another strain (♂) were put on the stigmas. These processes were conducted by hand and one may suppose that the emasculation is perfect and self-pollination might not occur.

In plants from (sub)tropical Australian populations, ripe seed is available one month after the pollination. However, in plants from temperate European and Japanese populations, more time was needed to obtain ripe seed. All seeds were harvested in September to October and stored in rain water in plastic vessels to avoid drying. Cultivation water was found to inhibit the subsequent seed

Table 1. List of *Aldrovanda* hybrids and their traits. The scoring of cold tolerance is rather subjective. Red parents are labeled in bold.

Parents abbrev.		Year of germin.	Growth vigor	Flowering frequency	Shoot color	Cold tolerance	Turion formation
♀	♂						
P	**W**	2009	moderate	good	red/green	low to moderate	Y
K	**D**	2009	good	moderate	slightly red	low	N
P	**S**	2009	moderate	low to moderate	slightly red	moderate	Y
R	**W**	2010	moderate	moderate	red	moderate	Y or N
H	**L**	2010	moderate	low to moderate	slightly red	low to moderate	Y
I	**B**	2010	moderate	low to moderate	slightly red	low to moderate	Y
L	**D**	2010	low to good	moderate	red	moderate	Y
T	**A**	2010	moderate	good	slightly red	moderate to high	Y ?
S	K	2010	moderate	low to moderate	slightly red	low to moderate	Y
B	**L**	2012	good	good	red	low to moderate	Y or N
V	**W**	2014	moderate	moderate	slightly red	moderate	Y
V	**E**	2014	moderate	low to moderate	slightly red	low to moderate	N
E	**S**	2016	moderate	moderate	red	low	N ?
P	**D**	2017	moderate	good	slightly red	moderate	Y

germination and, thus, only rainwater was used. The vessels were stored over winter in light on a window ledge in a non-heated room. I usually keep the overwintering *Aldrovanda* seed in light by the window as this species prefers light-induced germination (Cross 2012; Cross *et al*. 2016). Other stock seed is kept in darkness.

At the beginning of February, the water in the vessels was removed and the seeds were air dried. After two weeks, water was added into the vessels again. I usually use rain water, but a boiled-water extract with peat moss being properly diluted by rain water is preferable. In March, the vessels with seeds were transferred to a non-heated greenhouse so that the seeds were exposed to a sufficient light intensity. The seeds germinated regularly in May or June. However, in some cases, they did not germinate until the following year.

F1 hybrids, primary hybridization

For hybridizations, I used 12 parental *Aldrovanda* populations, which are referred to by the following abbreviations (see Elansary *et al*. 2010): A: Armidale county, N.S.W., E Australia; B:

Okavango delta, Botswana; D: S of Darwin, N.T., N Australia; E: Esperance Bay, W.A., SW Australia; H: Hanyu city, near Tokyo, Japan; I: Lake Ogura, near Kyoto (from Mr. Ishitaka); K: Lake Ogura, near Kyoto (from Mr. Naitou); L: Katherine, N.T., N Australia; P: E Poland; R: Lake Baláta-tó, Somody county, SW Hungary; S: Browlee near Sydney, N.S.W., SE Australia (from Mr. Kimura); T: probably Browlee near Sydney, N.S.W., SE Australia (from Mr. Takahashi); V: Danube delta, Romania; W: Kimberley, N.T., NW Australia.

So far, I have produced many F1 hybrids. In this review, I state only those which survived or have strongly remarkable traits (Table 1, see Figs. 1–3). When hybridization between red-colored strains was conducted, it was impossible to reliably identify the hybrid seedlings or young plants. Growing *Aldrovanda* populations for years, I estimated that hybrids possessed certain kind of a heterosis effect. I usually consider a heterosis effect if the hybrid plants withstand a one-year cultivation in a 500 mL PET bottle with *Sphagnum* peat moss as nutrient-poor conditions. Generally, under these conditions, wild parental strains cannot grow well or die soon.

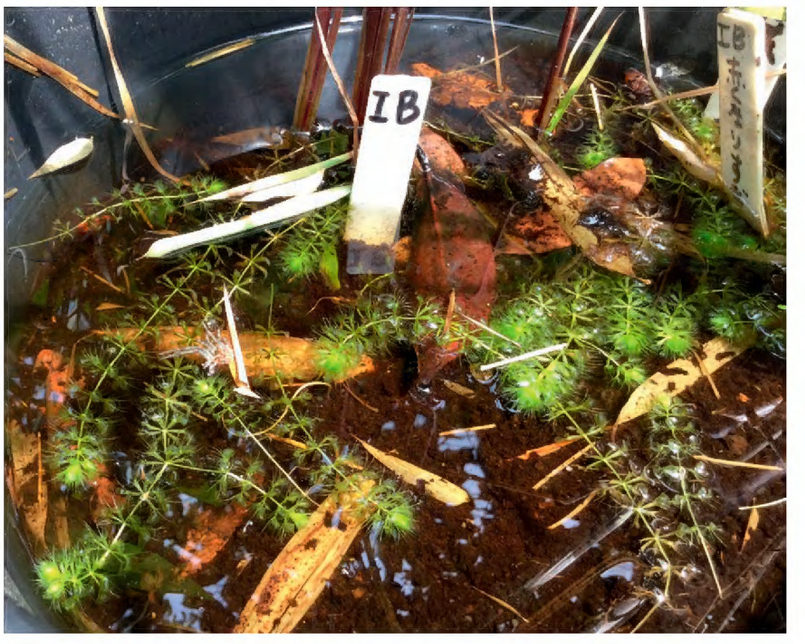

Figure 1: Hybrid IB *Aldrovanda* plants can be only slightly red, July 17, 2018.

Figure 2: Hybrid PD *Aldrovanda* plants form abundant flowers, July 24, 2018.

F1 hybrids, multiple hybridization

Multiple hybridizations of F1 hybrids among various *Aldrovanda* populations resulted in various combinations of traits of F1 plants. However, in these hybridizations, self-pollination is included and it is thus hard to distinguish them clearly from each other. These hybrids were grown in small containers and kept under stress conditions at low above 0°C temperatures during winter season in order to select healthy plants. The following hybrids have survived: PW × KD (germinated 2011); IB × BL (2013); KD × BL (2013); V × (S × probably D, 2014); BL × (KD × PW, 2015); BL × (IB or PW2 × V, 2015); BL × (KD × PW × ??, 2015); IB × V (2016); V × IB (2016); PW × IB (2016).

F2 hybrids

I conducted also several F2 hybridizations. The seeds and young plants from the same parents produced a great variability of all traits. Only two strains have survived finally. The hybrid PW2, which originated by self-pollination of the PW parents, had a moderate growth, its flowering was scored as moderate to good, its color could be green to (slightly) red, its cold tolerance was low to moderate, and it can sometimes form turions. The hybrid KD2 produced a good growth, its color could be green to slightly red, it had a low cold tolerance, and did not form turions. Its flowering traits are unknown.

Figure 3: Hybrid ES *Aldrovanda* plants are distinctly red and commonly flower, August 23, 2018.

Conclusions

Out of 12 worldwide parental *Aldrovanda* populations, I have succeeded in creating 14 confirmed hybrids so far. The hybrids between tropical and temperate populations also exhibit vigorous growth. All hybrids are fully fertile and normally set viable seeds. They have more or less intermediate traits as compared to their parents. It was not possible to decide reliably in some hybrids (RW and TA) whether or not they form turions. However, it seems that in the most cases with a few exceptions (KD, VE), if one of the parents (either from temperate or tropical populations or as pollen acceptor or donor) forms turions, also the hybrid forms turions. The same principle, without any exceptions, applies for red coloration by anthocyanins. It can thus be concluded that both dormant turion formation and anthocyanin production have a genetically dominant character (Adamec 2018).

Acknowledgements: I greatly appreciate all who provided parental populations. They were Mr. Takayoshi Kimura, Drs. Michiaki Mabuchi and Lubomír Adamec. Sincere thanks are due to Drs. Lubomír Adamec and Hiro Shimai, who gave me many pieces of helpful advice, and to Mr. Yukio Kosaka and Mr. Kazuyuki Takizawa, who kindly translated the literature to Japanese or English.

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Chemistry and surface micromorphology of the Queensland sundews (*Drosera* section *Prolifera*)

Jan Schlauer • Zwischenstr. 11 • D-60594 Frankfurt/Main • Germany • jan@carnivorousplants.org
Siegfried R. H. Hartmeyer and Irmgard Hartmeyer • Wittlinger Str. 5 • D-79576 Weil am Rhein • Germany • s.hartmeyer@t-online.de

Keywords: *Drosera*, Phytochemistry, Naphthoquinones, Chemotaxonomy, Micro-morphology, Trichomes, Emergences.

Introduction

The northern, tropical part of Australia is inhabited by numerous sundew species, of which most are endemic (Brewer & Schlauer 2018). In northernmost Western Australia and the Northern Territory these species predominantly belong to *Drosera* sections *Lasiocephala* Planch. (*D. banksii*, *D. subtilis*, and the "*D. petiolaris* group" or "woolly sundews") and *Arachnopus* Planch. (the "*D. indica* group"), while in northern Queensland a further section (*D.* sect. *Prolifera* C.T.White, the "rainforest sundews") of species with rosetted sessile (*D. adelae* F.Muell. and *D. schizandra* Diels) or petiolate leaves (*D. prolifera* C.T.White) adds to this diversity. *Drosera* sect. *Prolifera* is closely related to *D.* sect. *Arachnopus* (Rivadavia *et al.* 2003; Fleischmann *et al.* 2018a) but the plants are perennial and they prefer shaded or even forested situations at colline (200-500 m alt.) to montane (500-1000 m alt.) elevations, while the "Indian sundews" are annuals of sunny, usually lowland places. The distributional ranges of the three species of *D.* sect. *Prolifera* are geographically well separated from each other, and no native hybrids are known. Nevertheless, the artificial hybridization of *D. prolifera* and *D. schizandra* was successfully performed by Kamil Pasek in the Czech Republic. Unfortunately, the hybrid has not been described formally, so no cultivar name was established (it is, however, commonly on sale under the informal name "Andromeda").

The acetogenic naphthoquinones, plumbagin (P in this paper) and ramentaceone (7-methyljuglone, M in this paper), are important chemotaxonomic markers in sundews (*Drosera* L., Culham & Gornall 1994; Schlauer *et al.* 2017, 2018). The Queensland sundews have been screened for their naphthoquinones before (Culham & Gornall 1994) but the chemical diversity within the group has prompted our investigation of the hybrid and, subsequently, a re-evaluation of the published data. Additionally, the close relationship of the Queensland sundews with the "Indian sundews", which are known for their rich diversity of leaf and stem surface emergences (Schlauer *et al.* 2017, 2018), has made a micromorphological re-investigation (*cf.* Seine & Barthlott 1994) of *Drosera* sect. *Prolifera* worthwhile.

Materials and methods

The plants used in the present study were purchased from Thomas Carow (Nüdlingen, Germany), and from Kamil Pasek (Ostrava, Czech Republic), respectively. The methods used were the same as detailed previously (Schlauer *et al.* 2018).

Results

The naphthoquinones detected in the investigated species are summarized in Table 1.
The leaf surface micromorphology of the Queensland sundews is documented in Figures 1 to 4.

Table 1. Taxa investigated and quinones detected in the present study. M = 7-methyljuglone (and shinanolone); P = plumbagin (and isoshinanolone).

Taxon	Quinone(s)	Reference/Remark
Drosera adelae	M	confirms Culham & Gornall (1994)
D. prolifera	P	confirms Culham & Gornall (1994)
D. prolifera × *schizandra*	M+P	new (this study)
D. schizandra	M	Culham & Gornall (1994) did not detect quinones in this taxon.

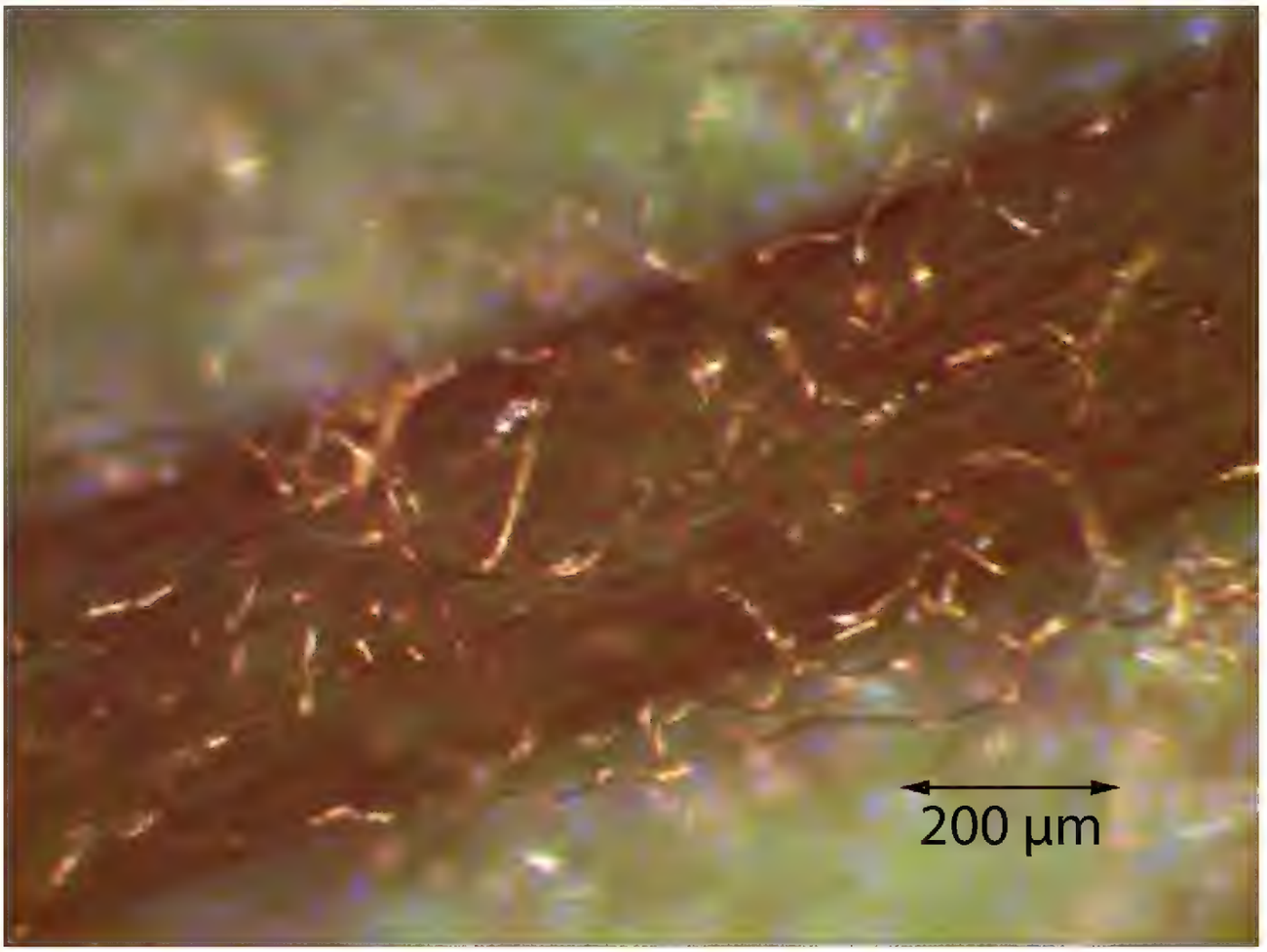

Figure 1: *Drosera adelae*. Lower leaf surface with many long, occasionally branched (dendritic) woolly trichomes and stipitate and sessile small glands. Photo: S. Hartmeyer.

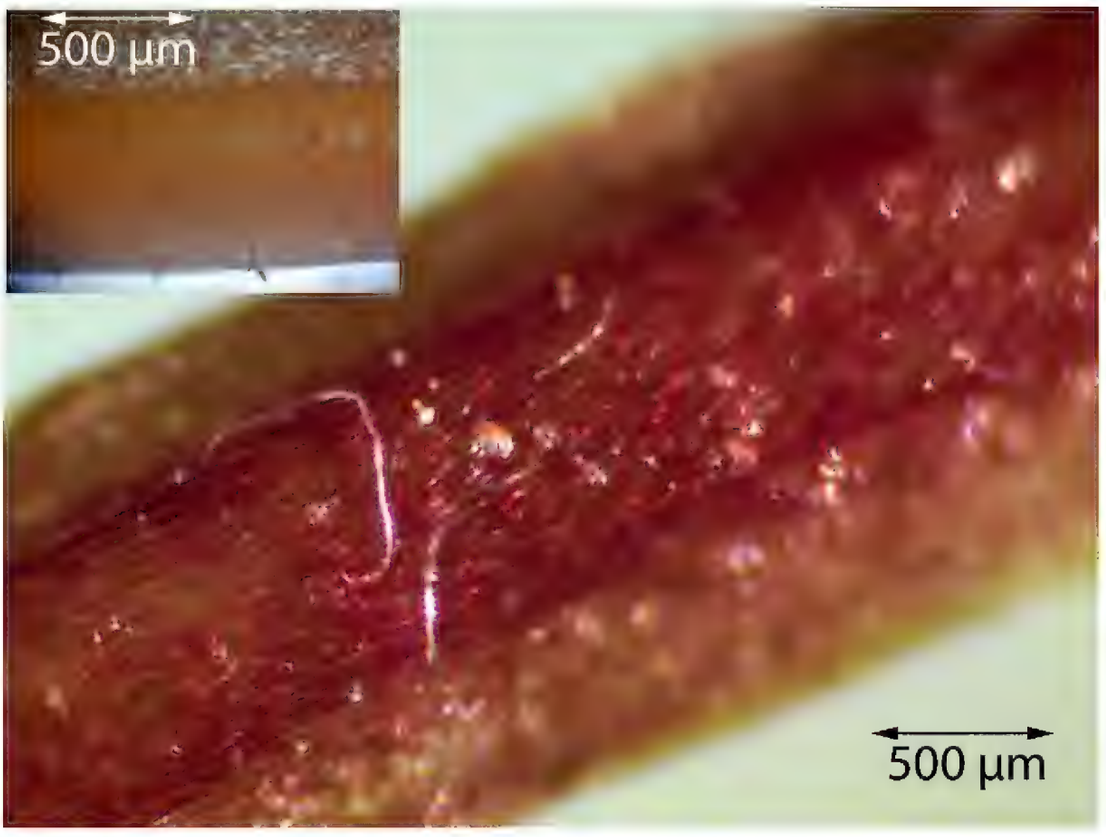

Figure 2: *D. prolifera*. Petiole with sparse long, woolly trichomes and sessile small glands. Insert: short biseriate trichomes consisting of ca. 10 globular (glandular?) cells. Photo: S. Hartmeyer; insert: J. Schlauer.

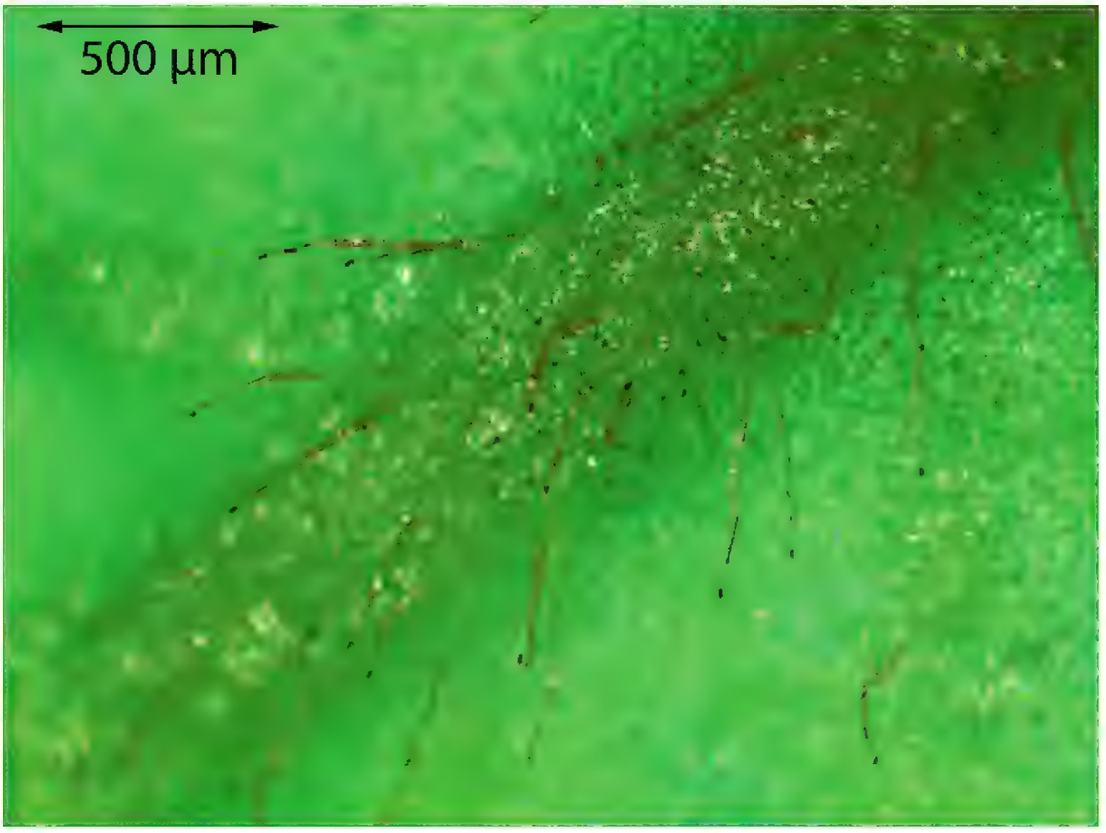

Figure 3: *D. schizandra*. Lower leaf surface with many long multiseriate glandular trichomes and sessile small glands. Photo: S. Hartmeyer.

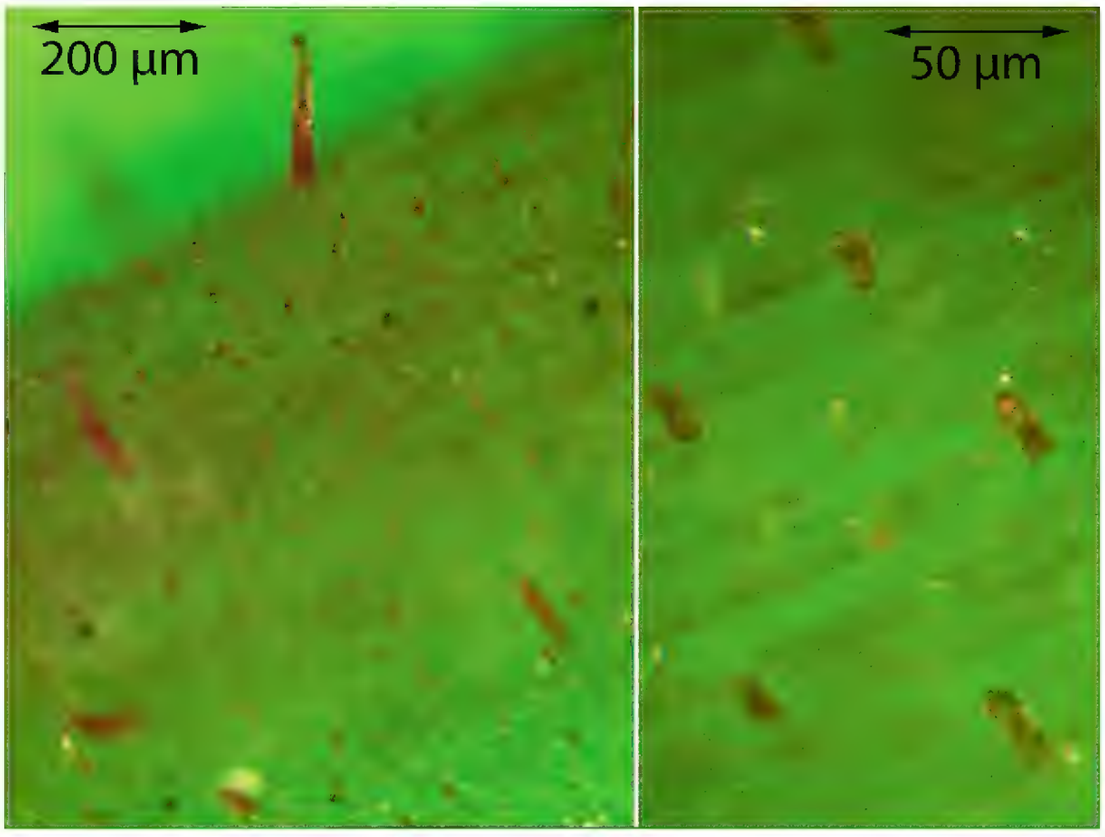

Figure 4: *D. prolifera* x *schizandra*. Left: stipitate glands with multiseriate stalk and short biseriate trichomes consisting of ca. 10 globular cells; Right: short biseriate trichomes at higher magnification. Photos: S. Hartmeyer.

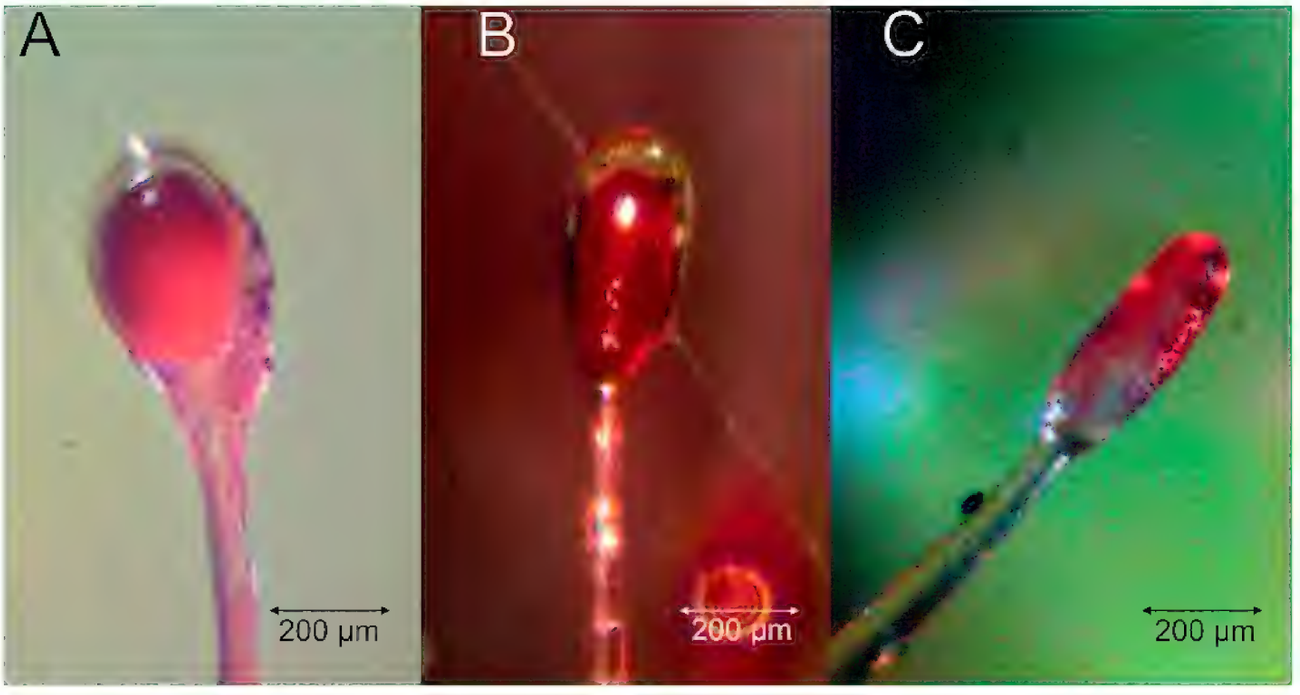

Figure 5: A = *D. prolifera* bilaterally symmetric marginal tentacle (with mucilage); B = *D. prolifera* x *schizandra* bilaterally symmetric marginal tentacle (mucilage removed for better visibility of gland); C = *D. prolifera* x *schizandra* transitional marginal tentacle (mucilage removed). Photos: S. Hartmeyer.

Discussion

Although only four accessions have been investigated in the present study, a number of noteworthy or even outright unexpected results have been obtained.

Naphthoquinones

The first surprise was the mixture of compounds (M + P) in the hybrid, in spite of the reported (Culham & Gornall 1994) absence of quinones in one of the parents (*D. schizandra*) and the presence of only one isomer (P) in the other parent (*D. prolifera*). However, our re-investigation of *D. schizandra* revealed it to contain M (and confirmed P in *D. prolifera* and M in *D. adelae*), which readily explains the quinone pattern of the hybrid, as the simultaneous presence of both isomers has been found in a number of hybrids between quinone-heterogenous parents (Schlauer & Fleischmann 2016). This also demonstrates that it may be useful to look for quinones in taxa that have not yielded any in previous tests. The production of quinones may be compromised by factors like growing conditions and developmental stage. So, the absence of metabolites does not necessarily constitute a reliable chemotaxonomical character, whereas the presence of specific naphthoquinones (and/or biogenetically related tetralones, Schlauer *et al*. 2018) is usually reproducible and taxonomically informative in sundews.

With the data now available it can be concluded that the two southern (south of Cairns) species *D. adelae* and *D. schizandra* (both containing M) with sessile leaves and non-proliferous scapes, are also chemically more closely related to each other than to the northern (north of Cairns) *D. prolifera* (that contains P) with distinctly petiolate leaves and with a "trailing" habit (new plantlets being produced from the tip of the scapes), while the affinities throughout *D*. sect. *Prolifera* are still close enough to allow hybridization.

Like the South Gondwanan *D*. sect. *Psychophila* (*D. uniflora*: M, *D. stenopetala*: M+P, Schlauer *et al*. 2019a & b) this small section displays a quinone diversity similar to its more species-rich relatives, *D*. sections *Arachnopus*, *Drosera*, *Ptycnostigma*, and *Brasilianae*.

Surface Micromorphology

The woolly trichomes of *D. adelae* (incomprehensibly not reported by Seine & Barthlott 1994) are reminiscent of similar trichomes in *Drosera* sect. *Lasiocephala*, in which especially *D. ordensis, D. lanata,* and *D. derbyensis* are notable for a particularly rich indumentum (Kondo 1984; Lowrie 1996). Similar trichomes are, however, also known from *D*. sect. *Brasilianae* (*D. graminifolia*, *D. villosa*, Fleischmann *et al*. 2018b) or *D*. sect. *Drosera* (*D. neocaledonica*, with shorter, stiffer hairs, Seine & Barthlott 1994; Schlauer *et al*. 2019a), that are phylogenetically more closely related to *D*. sect. *Prolifera*.

The long glandular trichomes of *D. schizandra* are obviously inherited (but with a shorter stalk and less numerous) in the hybrid with *D. prolifera*, while the latter contributes its unique short trichomes (Seine & Barthlott 1994) that are apparently glandular throughout their length.

In spite of the close phylogenetic relationship between *D*. sect. *Prolifera* and *D*. sect. *Arachnopus* there is little similarity in the indumentum between the two sections. Few if any surface excrescences (except the tentacles) in *D*. sect. *Prolifera* are actually emergences (with at least one strand of non-epidermal cells participating in the formation of the stalk), while even non-glandular hair-like structures (like in *D. aquatica* and *D. nana*, Schlauer *et al*. 2018, 2019a) are emergences in *D*. sect. *Arachnopus*.

Bilaterally symmetric marginal tentacles (with the gland on the adaxial side) that are present in *D. prolifera* (Seine & Barthlott 1994; Fig. 5 A) have never been observed in *D*. sect. *Arachnopus*. In

D. prolifera × *schizandra* bilaterally symmetric marginal tentacles (or transitional forms with just a slightly oblique gland, Fig. 5 B & C) are occasionally formed but much less frequently so than in *D. prolifera*. They are lacking in *D. schizandra*, so an intermediate condition (co-dominant inheritance) is seen in the hybrid also in this respect.

Acknowledgements: We thankfully appreciate the useful comments and corrections by Andreas Fleischmann and three anonymous reviewers, which have helped to improve this text.

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Book Review

Casper, S. Jost. 2019. The Insectivorous Genus Pinguicula (Lentibulariaceae) in the Greater Antilles. Softcover: Dimensions: 17.6 × 25 cm (B5), 126 pages, 60 color or black/white plates, 11 distribution maps. Botanic Garden and Botanical Museum Berlin, Freie Universität, Berlin. (February 6, 2019). ISBN 978-3-946292-30-2

Reviewed by: Yoannis Domínguez – yoannisd@gmail.com

Among the great diversity of *Pinguicula* species, the Greater Antillean taxa (Cuba and Dominican Republic) are among the less studied ones; therefore, the new work by S. J. Casper is a necessary contribution eagerly awaited by many readers. Over the last six decades, the author has devoted himself to the study of the genus *Pinguicula* and since the last formal revision of the genus (Casper 1966); several new species have been described, many of them by the author himself especially for the Caribbean region. In the new publication, Casper reviews and discusses his previous works as well as other related literature such as a recent work by Lampard *et al.* (2016), that focused on Latin American taxa and made changes on the circumscription of certain species. This new book therefore is a most welcome concise study of the insectivorous genus *Pinguicula* in the Greater Antilles carried out by the author over a long period of time and, at the same time it will be the formal treatment of the genus *Pinguicula* for the new *Flora de la República de Cuba*.

The new book consists of two main sections: "The species" and "General aspects" besides the summary, a list of abbreviations, acknowledgements, the introduction and the list of references cited on the text. The first section begins with a taxonomic key for 15 species treated in the text; meanwhile, the second section deals with general aspects of the genus *Pinguicula* such as morphological characters, distribution and palaeogeographical data, species differentiation, relationships among Caribbean species and other taxa, and a brief summary of molecular systematics studies that are being carried out in collaboration with other researchers. In spite of being a purely scientific work, it will be of interest not only to researchers working on this topic, but also to collectionists, growers, and enthusiasts of the genus *Pinguicula* since it gathers, in a single publication, a wealth of data otherwise accessible only with difficulty for many readers. The book is nicely printed full of plates and maps that are generally well reproduced and clear, although, some pictures are dubious and should be interpreted with caution regarding the identity of certain species that do not match the taxonomic key or the given species description.

A taxonomic key based on morphological characters is always welcome and very useful; not only for botanists, but also for the general public interested in identifying the species that in the particular case of *Pinguicula* can be a difficult task. Moreover, the presented key is an accurate hit of the author due to the lack of this kind of material in recent works especially for the Greater Antillean species. The key is dichotomous, non-indented, and although it includes some microscopic characters it is easy to use without the need of a microscope. However, it is a pity that the species that causes the greatest confusion among Cuban species (*Pinguicula benedicta* Barnhart) has been not included in the key.

The first section continues with 16 subsections, each one dedicated to each taxon arranged in alphabetical order. In the account of each species the author follows a nice sequence of topics starting with comments on historical, taxonomic, and nomenclatural facts which I found very useful to understand the species' circumscription adopted by the author for the delimitation of certain taxa. After that, a detailed morphological description, richly illustrated, gives the reader a clear picture of

each species; even though some pictures are ambiguous or do not clearly represent the description given in the text (e.g. Plates 17 and 56 that represent the former *Pinguicula toldensis* Casper). Examined specimens and photographs are also cited as well as information on distribution and habitat, and finally a discussion including comparisons between the treated species and other species with which it has been or can be confused. The final discussion for each species also provides readers with relevant details to clearly discriminate species that have been considered conspecific, such as *Pinguicula jaraguana* Casper and *Pinguicula lithophytica* Panfet & P.Temple.

Taxonomic novelties include three new species from eastern Cuba: *Pinguicula baezensis* Casper, *Pinguicula moaensis* Casper, and *Pinguicula orthoceras* Casper and the synonymization of *Pinguicula toldensis* with *Pinguicula caryophyllacea* Casper. I confess that when I had knowledge of the three new species I thought that they would be merely variations of the doubtful *Pinguicula benedicta* but, at the moment, after reading the text and analyzing the data I accept the author's view until the "*Pinguicula benedicta* puzzle" be properly studied and solved.

I have detected some problems regarding the incorrect citation of certain type specimens that must be corrected. That is the case of *Pinguicula jackii* Barnhart for which the author cited the holotype as kept at the herbarium of The New York Botanical Garden (NY). The only specimen I have found that match the type of *P. jackii* (*J.G. Jack 6794*) as indicated by Barnhart (1930) is housed at the Smithsonian Institution herbarium (US) along with other original materials (paratypes: *J.G. Jack 7886*, *7942* and *L.H. Bailey 12443*), one of them with duplicates at the Cornell University herbarium (BH) and The New York Botanical Garden herbarium (paratype: *L.H. Bailey 12443*). The other case is more serious since it comprises the type specimens of *Pinguicula benedicta* and *Pinguicula lignicola* Barnhart. Along the text and in previous works (Casper 1966, 2003, 2004, 2007), the author claims that such specimens were in loan at the herbarium of the Botanical Museum Berlin-Dahlem (B) when Ernst was preparing his review on *Pinguicula* (Ernst 1961) and they were destroyed in a bombing raid during World War II; however, I have not found any evidence that these materials were ever at B. On the other hand, when the author discusses the taxonomic status of *P. benedicta*, he recognizes that Ernst did not cite any examined material (footnote 47, p. 103); therefore, I wonder how the author concluded that at some point these materials were in Berlin. Since the beginning of his studies, the greatest difficulty the author has had regarding *P. benedicta* has been that he has never examined the type specimen or any original material and has adopted Ernst's view (Casper 1966) but, where is the original material (holotype?)! I strongly believe that a set of specimens housed at the Arnold Arboretum Herbarium of the Harvard University, which are identified as types (*P. benedicta* barcode 00093357 and *P. lignicola* barcode 00093359) and syntype (*P. lignicola* barcode 00093358), represent the "lost holotypes" and a paratype of *P. benedicta* and *P. lignicola* since they match exactly with the information given by Barnhart (in Britton 1920) in the protologues. I have examined images of these specimens (see also Schlauer 2019) and I believe that a deeper study of the *P. benedicta*'s specimen can shed light on the identity of this species and the so-called *P. benedicta* species group.

At the end of the species' section the author discusses "The '*Pinguicula benedicta* puzzle': the dubious taxon *P. benedicta* and the *P. benedicta* species group" but once again he could not clarify the situation and states that "no specimens have been found that can without doubt be unequivocally attributed to Barnhart's taxon". Moreover, the author says that "if we want to perfectly solve the problem, we should reject Barnhart's name" what seems to me totally inadequate, although understandable, because apparently, he does not know about the existence of these original materials.

The second section is just over one tenth of the book (13 pages) and it opens with a general discussion of selected morphological characters typical of the genus and the particularities of them

in the Antillean species. Some of these characters have been already illustrated and discussed in the first section; whilst, others like the chromosome numbers are now discussed in comparison with other species, and pollen and seed characters are only briefly presented due to the lack of more specific studies. Flower shape is also illustrated in comparison with selected Mexican taxa although the author only refers these figures in other topics later in this section.

It is always a pleasure for me to read the author's biogeographical insights and this passion began when I first read his work on the Andean species (Casper 1984) which I found exquisitely detailed. In the present work the discussion of palaeogeographical aspects of the Antillean species are also well presented and, although it is mostly theoretical and did not present any experimental data, it is really worth reading. Nonetheless, I question the speculation that the ancestors of the modern Caribbean *Pinguicula* reached its current distribution around the Upper Miocene and Pliocene (9-3.7 mya). Without direct proofs like palaeobotanical data and/or time-calibrated phylogenies it is risky to propose such hypothesis just based in the background data cited by the author.

Regarding the patterns of differentiation of *Pinguicula* in the West Indies, the author presents five groups of species using different combinations of floral characters (i.e. corolla color and morphology) as grouping pattern. Moreover, other floral characters (e.g. flower shape and presence/absence of a palate-like structure in the corolla) and chromosome numbers are used to discuss possible relationships of the treated species with other species or species groups although, it is inconclusive and suggests the necessity of further studies regarding the infrageneric classification of *Pinguicula*.

Finally, the author slightly explores new insights on the relationships of Caribbean *Pinguicula* species based on preliminary results of molecular phylogenetics analyses that are mostly incongruent with the morphological characters formerly exposed. Since the author's own studies are still being carried out and have not been published, preliminary results are discussed in comparison with previous studies. Nevertheless, I would have liked to see a phylogenetic tree which should help to interpret the text for those readers that have not a clear understanding on evolutionary processes and phylogenetic analyses. This topic ends with a summary of the overall results obtained for the study group using classical and modern techniques; hence, we should expect changes in the infrageneric classification in the near future.

In conclusion I would have welcomed a more careful editing; including the deletion of some passages in German that are also presented translated to English which would have make the book more readable. I also would have liked to see a solution for the *P. benedicta* species group. These critical points should however not detract from the fact that the author, with this work, has provided us with an unusually detailed and useful account of the genus in the Greater Antilles. Just a few groups in the genus have been treated in such detail and this book will therefore be useful not only to those interested in the Caribbean species, but to everyone interested in *Pinguicula* as a whole and carnivorous plants overall.

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The *Pinguicula benedicta* "puzzle" resolved

Jan Schlauer • Zwischenstr. 11 • D-60594 Frankfurt/Main • Germany • jan@carnivorousplants.org

In his recently published monograph on the genus *Pinguicula* in the Greater Antilles, Casper (2019: 100) writes with respect to the "dubious taxon" *P. benedicta* Barnhart: "Holotype: Cuba, Oriente, trail [from] Camp La Barga to Camp San Benito 43, 23 [" 22-26 "] Feb 1910, Shafer 4025 (NY, destroyed in 1943 while on loan to B) "

There is apparently no original material in the New York herbarium (NY), and the assumption that it was destroyed in Berlin (B) cannot plausibly be refuted. It should, however, be noted that Barnhart (1920: 110) did not specify the herbarium in his original type reference, and (as already noted by Shimai 2017: 274) there is a well-preserved specimen of "Shafer 4025" in the herbarium of the Arnold Arboretum (A, barcode 93357) (https://s3.amazonaws.com/huhwebimages/AFF6F6B7193F4F2/type/full/93357.jpg accessed on 3 April 2019).

Barnhart's statement "the 5 lobes all oblong, entire, overlapping" is somewhat misleading. The "Material from Packet" (dissected parts of a corolla) of the scan quoted above, which may have led to this claim, has indeed fairly broad petal lobes overlapping at their lateral margins, but on the same sheet a number of flowers have clearly spreading and even quite narrow ones: a situation that Casper himself (l.c.: 41, under *P. caryophyllacea* Casper) described as "typical *P. caryophyllacea* characters in the middle of '*P. toldensis*' characters!"

Also, Barnhart's statement "corolla (...) dark blue" is at most suitable for the distinction from "white" (for *P. lignicola* Barnhart that was described simultaneously and almost simultaneously collected in the same region). Shafer himself did not indicate any color on the label (and only wrote "blue" in his notes). Barnhart may simply have deduced the original color merely from the dried specimen.

The assumption that no original material from *P. benedicta* is extant (l.c.: 103) is thus refuted, a neotypification (considered l.c.: 104) is consequently out of the question, as is the idea to reject Barnhart's formally flawless name. Available evidence clearly indicates that *P. benedicta* is the first validly published name for plants with a corolla shaped like in *P. toldensis* Casper (that was collected some 10 km apart and which is quite rightfully united with *P. caryophyllacea*, l.c.: 31).

With this insight, the names *P. caryophyllacea* and *P. toldensis* become later synonyms of *P. benedicta*, as already proposed by Lampard *et al.* (2016).

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The portrait of *Pinguicula involuta* Ruiz & Pavon in the "Flora Peruviana": A botanic detective story

S. Jost Casper • Waldpark Seniorenheim • Prellerstr. 16 • D 01309 Dresden • Germany • jost.casper@arcor.de
Frank Hellwig • Friedrich-Schiller-Universität Jena • Institut für Spezielle Botanik • Philosophenweg 16 • D-07734 Jena • Germany

On March 31, 1788, the pharmacognost and botanist Hipólito Ruiz López (Hipólito Ruiz), the pharmacognost Antonio Pavón Jimenez, and the draftsman Isidro Gálvez Gallo returned to Spain after an approximately ten-year long expedition (1777-1788) to the Viceroyalty of Péru. The plant hunters of the team had been very successful: they collected about 3,000 specimens of plants and made about 3,000 life-sized colored botanical illustrations. Of these, 2,230 survived and are preserved in the Archives of the Royal Botanical Garden of Madrid. They described about 150 new genera and 500 new species. In 1798, the first volume of the "Flora Peruviana, et Chilensis... et icones..." together with their "Systema vegetabilium..." were published. These volumes were preceeded by the 1794 edition of the "Florae peruvianae, et chilensis ...prodromus...". The travel itself was described in detail by Hipólito Ruiz *et al.* (1940)[1].

Pinguicula involuta (Front Cover), our subject of desire, was described in the "Flora Peruviana et Chilensis..." (Ruiz & Pavón 1798a, 1: 20) and in their "Systema vegetabilium..." (Ruiz & Pavón 1798b: 136). The diagnosis runs, identically in both publications, as follows: "P[inguicula]. nectario conico longitudine petali, scapo unifloro villoso, foliis ovatis, marginibus involutis."

The feature "rosette leaves ovate with margins rolled inwards" was the crucial factor for naming and binding of the nomen specificum *involuta*. However, initially another epithet was preferred. From the "Travels..." (Ruiz *et al.* 1940: 42) we learn that, on May 26, 1779, the collectors began their excursions and journeys "...through the montañas of Huasahuasi [sic!] and Palca..." of the province Tarma, and continued them "...to the April 24th, 1780... During this time, we discovered a considerable number of trees, shrubs, grasses and herbs... all of which will be described extensively in the Flora of Peru, and I restrict myself here to indicating their generic and trivial names..." In the list of the plants, we read on page 45 "*Pinguicula stellata*" without any additional remark.

In chapter XLVIII (Ruiz *et al.* 1940: 229) it runs (with reference to the activities in 1787): "During our excursions through the montañas of Pillao and Chacahuasi I gathered and put in press a great number of plants, of which some were sketched, and I described the following."

Finally, in their "Flora..." as well in their "Systema vegetabilium..." Ruiz & Pavón substituted the epithet "*stellata*" by "*involuta*" based on the feature "foliis ovatis marginibus involutis". Apart from this feature, *P. involuta* is distinguished by the corolla upper-lip lobes much shorter than the lower-lip ones and by the relatively long (about as long as the corolla lobes), slender, and cylindric but slightly curved spur.

The new *Pinguicula* species is illustrated nearly life-sized in color on lamina XXXI, fig. c (see Fig. 1 left). Four taxa are illustrated on this plate: *a Calceolaria virgata, b Utricularia unifolia, c Pinguicula involuta, d Utricularia aphylla*. This fact alone indicates that the painting is a combina-

[1] The report of the excursions by Ruiz entitled "Relación del viaje hecho a los reynos del Perú y Chile..." prepared from his journals and completed for publication in 1793, remained unpublished in his lifetime. In 1931 it was published in Madrid. We studied the edition of 1940 in Dahlgren's English translation.

Figure 1: Left: Photocopy of the printed plate from Ruiz & Pavón (1798a) Flora Peruviana… 1: Lam. XXXI with the watercolor portrait of *Pinguicula involuta*. Right: Photocopy of the original drawing of Joseph Rubio (signature on the bottom left-hand outside the frame) from Archivo del Real Jardin Botánico (CSIC: AJB04-D-0066_00), Madrid. Div. IV. Photocopy reproduced with permission.

tion based on various patterns.[2] The portrait is attributed to the draftsmen J. Brunete[3], F. Pulgar[4], and J. Rubio[5] as the signatures on the bottom left-hand outside the frame shows. The engraver of this illustration included their signature ("P. Suria") at the bottom right corner, outside the frame.

Who of the named three artists painted our *Pinguicula*? Is the fine portrait a true-to-life illustration?

From the "original" drawing preserved in the Archivo del Real Jardin Botánico Madrid (CSIC: AJB04-D-0066_00; see Fig. 1 right) it seems to be evident, that Joseph Rubio painted the entire plate XXXI. He added the names of the plants on the bottom outside the frame, too. (The engraver is not signed). J. Rubio had joined the Flora Peruviana team at Madrid in 1792. As he had never been in Peru, his drawings relied upon information given by the members of the expedition, the collected specimens, and the original drawings made on the spot, which are now housed at Madrid.

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[2] José Brunete drew *Utricularia bifida* (= *Utricularia aphylla* (lam. XXXI, fig. d). Whether he also drew *Utricularia unifolia* (lam. XXXI, fig. b), we could not find out. Besides *Pinguicula involuta*, J. Rubio drew *Calceolaria virgata* (lam. XXXI, fig. a).

[3] José Brunete was the "first draftsman" of the expedition. He did not return to Spain. He died in Pasco in 1787 (Pupulin 2012).

[4] In May 1784, Francisco Pulgar (together with the botanist Juan José Tafalla Navascués, who replaced J. Dombey who had left the group four weeks before.) joined the expedition team in Peru and remained there until he died in 1815.

[5] In July 1792, Joseph Rubio was nominated director of engraving of the Flora Peruana by the "Junta de la Flora" and, in November 1793, as draftsman.

Figure 2: *Pinguicula involuta*, lectotype MA 815471. In the plate center the unusual specimen(s) with eight long stalks, some fruitless. This is presumably the source material for Rubio's drawing. Photocopy reproduced with permission

Following Dominguez *et al*. (2017:185) it is likely that as J. Rubio prepared the painting of *Pinguicula involuta* (Ruiz & Pavón 1798a: lam. XXXI, fig. c), he had in his hands the specimens of MA 815471. This specimen is unusual because of the large number of scapes developed on a presumably solitary *Pinguicula* rosette (see Fig. 2). This specimen bears eight leafless scapes curving upwards, none with flowers and fruits, but with seven retaining calyces. J. Rubio's drawing shows also eight scapes, four flowering and four fruiting, the latter shorter than the flowering ones (see Fig. 1). Apparently during the making of the plate, the draftsman supplemented the specimen with flowers and fruits missing on the voucher. He might have used the single flower that is conserved on specimen MA 815471 as his model, however, did he do so? In spite of the apparent similarity of the drawing to the specimen on MA 815471 some problems remain. First, the flowers are drawn too beautifully, and do not correspond with preserved specimens. Second, the spurs are drawn sickle-shaped, unlike

the slender-cylindric ones in nature. Finally, the leaf rosette is drawn too schematically and does not compare well with the dried specimen. Apparently, it is unclear whether the illustration is based upon one or several specimens.

Does the Rubio-drawing reproduce the real character of the taxon in question? The generative parts (i.e. flowers and fruits) are the product of fantasy. A true-to-life illustration would have shown extremely short stalks with overhanging flowers overtopped by mature fruiting stalks. (As a rule, the fruiting scapes of *Pinguicula* are longer than the flowering ones and are not pendent.) The vegetative part, i.e. the leaf rosette, is drawn as a regular star with eight oblong (instead of ovate, as described in the protologue) leaves whose margins are hardly curled up. Rubio's portrayal (as seen in Fig. 1) is a diagram rather than a realistic illustration. Rubio's illustration is an idealization of a plant he never saw in life.

Surprisingly, such a true-to-life illustration of *Pinguicula involuta* exists!

The portrait, housed in the Archivo del Real Jardin Botánico (CSIC), Madrid, shows a dense cluster of green leaf rosettes forming a kind of cushion consisting of seven flowering and five budding plants (see Fig. 3). The very short (10-20 mm long) scapes bear blue flowers about 9-12 mm long. Fruiting specimens are not drawn. The leaf rosettes are star-like ("stellate"), the leaves are oblong with margins curled up. Below and to the left of the main picture is a single, isolated stalked open flower calyx. The plate is numbered XXXI, the portrait is signed by Fran.co Pulgar (inside the frame left-hand at the bottom), and is named "*Pinguicula stellata*", on the bottom outside the frame.

Figure 3: *Pinguicula stellata*. Photocopy of Francisco Pulgar's drawing. Archivo del Real Jardin Botánica (CSIC), Madrid. Div. IV. Photocopy reproduced with permission.

From the artist's name F. Pulgar and the epithet *stellata* it is evident that the portrait was made in Peru during the expeditions to Panao and Chucahasi, which occurred after May 1784[6], after the devastating fire in Macora in 1785. Most probably it was made in 1787 (Ruiz *et al.* 1940: 229-230). Pulgar didn't draw "on-the spot" however; he probably worked with fresh flowering material brought to him by the botanists.[7] Together with their information, he designed a picture that is almost life-like as comparison with modern photographs of the taxon in question shows (see Figs. 4 & 5). The epithet "*stellata*", known to us otherwise but from Ruiz' journal of travels (1940: 45, 230),

[6] Cf. footnote 4.

[7] As noted in Puig-Samper (2012): "Our artists… work… without leaving to go to the field or forest and without the hikes the botanists do…"

is an additional argument for the assumption of the Peruvian origin of the Pulgar plate.

During the making of the first volume of the Flora Peruviana, the Pulgar portrait and the epithet *stellata* "disappeared". After its return to Madrid in 1788, the expedition team immediately started its work in preparing Prodromus, Systema vegetabilium, and Flora of Peru and Chile, which were produced 1798 and the following years. Ruiz examined the material collected—especially checking the vouchers and paintings—made detailed descriptions of the collected plants (and animals), and arranged the illustrations for printing. After November 1793, José Rubio was responsible for making a great part of the plates of vol. 1 of the Flora Peruviana – 77 plates were attributed to him. Apparently, Rubio was prompted by Ruiz(?)[8] to combine the available paintings, vouchers, and descriptions of *Pinguicula stellata* to draw a picture of a single specimen representing the new species. In the process, its name was changed into *Pinguicula involuta*[9].

Figure 4: *Pinguicula involuta*. Inca Trail Peru. Cluster of star-like leaf rosettes. A single elongated and erect fruiting scape (center) is visible. Apart from the fruiting scape, such a living individual could have been the pattern of Pulgar's portrait of *Pinguicula stellata*. Photograph: F. Rivadavia, with permission.

Figure 5: *Pinguicula involuta*. Inca trail Peru. Short-stalked flower in midst of a dense cluster of star-like leaves (its margins heavily curled up). Photograph: F. Rivadavia, with permission.

Many questions remain regarding the production of Rubio's illustrations. We believe that Rubio had in his hands the painting of Pulgar—otherwise how does he know the shape and color of the flowers? But why did he present a specimen with both flowers and fruits, as he had never seen living or dried specimens? Had he been instructed by the botanists?

Rubio's isolated single specimen of plate XXXI is not the product of true-to-life drawing, it is the result of combination of various sources available to him. But is it mainly the result of elaboration on his part? Or is it the result of the addition of elements (perhaps imagined) by a number of artists and botanists?[10] It may be that Ruiz favored the final single-specimen-version against the original cluster-version to bring the picture in line with the other plant portraits of the Flora Peruviana.

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[8] In the first half of 1794, the "Prodromus" was finished and the expedition members could prepare the descriptions and drawings for the first volumes of the Flora Peruana. Originally, I. Galvez, the first draftsman of the expedition, had to complete and perfect the drawings before handing them over to the engravers. We could not determine how deeply the real Jardín Botánico senior professor C. Gómez Ortega was involved in the preparation of the Flora Peruana. He ended his participation in his Flora Peruana activities at the end of May 1794. The description of the new species of the genera already known to science was performed between 1795 and 1804 (cf. Rodríguez Nozal 2007).

[9] This is not the only case where a field (working) *Pinguicula* name was changed—Bonpland replaced *Pinguicula loxensis* with *Pinguicula calyptrata* and *Pinguicula Mexicana* by *Pinguicula moranensis* (Casper 2003).

[10] This is a clear violation of the official "instructions to the artists" given to J. Brunete and I. Galvez at the beginning of the expedition, that was to strictly copy nature in their production without adding elements of imagination.

Our study has shown that the printed portrait of *Pinguicula involuta* in Ruiz-Pavón's Flora Peruviana (1798a, Vol. 1, lam. XXXI, fig. c), has been drawn by Joseph Rubio. The artist made the illustration in Madrid after 1793, based upon the descriptions from botanists (apparently Hippolito Ruiz), the preserved dried specimens of the plants (probably collected 1787 between Panao and Chacahuasi in Peru), and the original color drawing of a cluster of a blue flowering *Pinguicula* made by Francisco Pulgar in Peru (initially named *Pinguicula stellata* by Ruiz).

Rubio's portrait does not represent a true-to-life illustration of the specimen. It differs from reality by the following features:

1. The characteristic dense cluster-like growth has been given up in favor of an (allegedly) isolated growth of a single specimen.
2. The leaves of the rosette lack the heavily curled up margins.
3. Short overhanging fruiting stalks and overtopping flowering stalks rise from the leaf rosette. In reality, the relation of length between flowering and fruiting stalks is quite different; the fruiting flower stalks are erect (never overhanging), and distinctly overtop the flowering ones.

The Rubio portrait of *Pinguicula involuta*, and—to a certain degree—the original description in the Flora Peruviana can no longer been assessed as accurate. A modern concept of the taxon has to consider the Pulgar drawing and, naturally, the actual findings from recent collections.

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Growing *Drosera murfetii*

Mark S. Anderson • Vancouver • Washington • USA • bluemax@mailbolt.com

In the few years since *Drosera murfetii* has become separated from *Drosera arcturi* as a new species it has become available to growers, though it is certainly not available everywhere. I feel it is sufficiently unusual and interesting to deserve a place in many carnivorous plant collections. I began growing this species several years ago when a generous group of friends gave me a plant, along with an implied "Good luck!" since little was known about its culture. Here are some of my experiences and thoughts about keeping this fascinating species alive and, maybe, thriving.

Drosera murfetii is an odd-ball among sundews (Back Cover). With its strange simple-looking leaves with tentacled ends *D. murfetii* looks like nothing else, other than *D. arcturi*. It has been called *D. arcturi* "giant form" before it was given species status. The leaves are spear-shaped with a pronounced mid-rib and are sometimes completely without tentacles (Fig. 1). They have a 'v'-shaped cross section, the two longitudinal sides separating as the leaf develops. Not very sundew-like. What is very much as you would expect is the tentacles. These grow along the upper surface of the leaf from 1/3 to 2/3 of the length farthest from the main plant and extending to the tip. Another strange thing about this species is the tentacles along the edges generally bend around the leaf to the back side of it. An adaptation allowing the plant to catch insects crawling up or landing on this side of the leaf? *Drosera murfetii* plants generally will have fewer leaves than are common with other *Drosera* and plants with only one leaf, or none, are not uncommon. Or the plant might have 2 or 3 leaves and not a single tentacle among them. I am still mystified as to what triggers the production of non-carnivorous leaves but they seem often to come in groups. A larger plant might have 5 or 6 leaves in the height of its growing season.

Figure 1: *Drosera murfetii.*

I have found that *D. murfetii* does best for me in pure long-fiber sphagnum (lfs) moss. Does that mean it won't grow well in a peat/perlite type of mix? Not necessarily. It might grow well in living sphagnum moss, or it might not. But in my conditions re-hydrated lfs, not too well-packed, seems to get the best results. I water by keeping the plants in standing water in a tray constantly. If you top-water, for instance, perhaps your plants would do well or even better in another medium. There is still a lot to be tried.

I have tried to grow this species in several conditions but the most successful has been in my garage window. Here the plants get seasonal temperatures from approximately 38°C in summer to 2°C

in winter and they are subjected to humidity fluxes from very high to quite low, depending on the season – and whether or not the clothes dryer has been running. The window in the garage doesn't get any direct sunlight, though there is some reflected off of the neighbor's house next door. To bring up the light levels to approximate full sunlight I use both florescent fixtures and clamp-type fixtures, in which I put standard Edison-type screw-in LED bulbs in the 100-watt equivalent range (~15 watt). I like these because they can be easily moved to fill in darker spots as needed. Since this space never freezes but does have cool temperatures in winter there are generous seasonal temperature shifts without the danger of frost. It would be interesting to see how *D. murfetii* does in full-on temperate winter conditions but I haven't tried it. In my conditions they don't even form anything resembling a winter bud or develop any kind of different leaves as winter approaches, though old leaves may slowly die back leaving only a spike-like green appendage sticking out of the soil. This is what the next leaf will develop out of. Often, they gradually slow in growth until they just kind of stop, at least as far as can be seen. The same thing happens in the heat of summer. It seems to be the in-between times of spring and autumn when the most growth occurs. *Drosera murfetii* is a slow-grower compared to other sundews, though it may have growth spurts when conditions support it. Still, it is not uncommon to have only a single leaf on a plant. In addition, it is possible for a plant to have leaves but no carnivorous leaves. At these times it looks a lot like the foliage of a lily. During the winter period when nothing visible is really happening with the plant, I continue to keep water in the watering tray.

Last year in the spring, for the first time, my plant produced a flower spike (Fig. 2) and later it produced seed. Following that, the main plant divided into 5 growth centers which I later split into separate plants. I am not certain what triggered blooming, but increasing photo period and rising daily temperatures along with lots of food in the previous season were possibly responsible. It is worth noting that leaf cuttings can be taken, if the plant can spare them, and floated in water the way *Drosera* leaves are generally propagated. They are slow to strike but given 1-2 months, plantlets will form under bright lights. This was discovered by Djoni Crawford who kindly shared her discovery with me. I have yet to try root cuttings, but they seem a good bet for increasing plant numbers.

Figure 2: Flowering *Drosera murfetii*. Stigmas can be red, white, or pink, depending on location.

The Venus flytrap: how commercial nurserymen and plant conservationists might co-operate to preserve wild populations and avoid a federal listing as endangered

Thomas Gibson • 205 Danbury Court 2A • De Forest • Wisconsin 53532 • USA • thomasgibson187@gmail.com
Don Waller • Dept. of Botany • Univ. of Wisconsin-Madison • 430 Lincoln Dr • Madison • Wisconsin 53706 • USA • dmwaller@wisc.edu

Everyone knows the remarkable and unique Venus flytrap (Fig. 1). What many do not know is that populations of this well-known species are highly restricted to a small area of North Carolina and adjacent South Carolina and that these wild populations are going extinct, disappearing before our eyes. For decades, the flytrap was one for the most commercially exploited plants in the United States (Kral 1983: p.545-548) with an estimate of tens of millions being field-collected and sold to the general public after WWII (see Fig. 90 in Evans *et al.* 2012). Although poaching of plants for illegal sale continues (Evans *et al.* 2012), other factors now contribute more to its decline in nature, including habitat destruction, development of its savanna habitats, lack of fire, and drainage of the wet pine savannas. Recent estimates are that just 42 populations of flytraps remain totaling perhaps 86,000 plants (Evans *et al.* 2012: p.134). Camp Lejeune has a large and dense population, perhaps reflecting the frequency of fire there, but it is not explicitly protected.

Figure 1: Venus flytrap, Green Swamp, North Carolina. Photo by Jim Fowler with permission.

These worrying declines in wild populations led to a pending petition requesting the U.S. Fish & Wildlife Service to list the Venus flytrap as Federally endangered (Waller *et al.* 2016). Listing the flytrap as Endangered under the 1973 Endangered Species Act (ESA) would clearly benefit wild populations. However, conflicts might arise as listing this plant could interfere with the large commercial market in flytraps. Most of these are commercially propagated via tissue culture, meeting ethical standards, with millions of plants sold each year to the public. An Endangered Listing, however, would prevent or complicate inter-state and international commerce in these plants, potentially threatening the livelihood of some commercial growers and traders of these plants. Restricting legal markets could also favor a black market in flytraps, potentially accelerating the poaching of wild populations.

To resolve potential conflicts in advance, we propose to link commercial trade in flytraps directly with the *in situ* conservation of wild populations. Most who buy flytraps would readily support conserving wild populations. Why not take advantage of this goodwill by asking every retail buyer to voluntarily pay a $0.25 to $0.50 surcharge on each Venus flytrap sold? This would involve asking commercial nurserymen to affirm that they have ethically propagated the flytraps and setting up a small program to confirm these certifications. Most nurseries are already following ethical practices

that protect wild populations. By participating in a public campaign to sustain wild populations of this species, they would broaden public appreciation and concern for the species and possibly expand the overall market. Given the volume of sales of flytraps, this source of revenue could amount to millions of dollars per year, enough to both administer the program and acquire and protect the wet longleaf pine habitats that sustain wild flytrap populations.

To make this program visible, plants from participating sources would carry a special brightly-colored tag signaling their ethical source and informing buyers how they are supporting the conservation of wild Venus flytraps. The tag and program would signal buyers as to which growers are responsible and concerned. The tag would also include a web URL so those interested could learn more about the biology and conservation of flytraps. The program could be rolled out with publicity and a press release to raise awareness about the plight of wild populations and to build public support for the surcharge.

A Board including both participating commercial nursery growers and leading plant conservationists would direct and oversee the program, ensuring that the funds collected were wisely disbursed to efficiently protect existing populations. Funds raised in this way could be used to purchase and protect additional lands, augment depleted populations, and manage and restore degraded habitats by protecting the hydrology of habitats and burning them as needed to rejuvenate populations. While some commercial nurserymen might be indifferent to protecting flytrap populations in nature, those participating could advertise their participation to signal their concern, potentially increasing their market among concerned buyers and thus revenue. As the public became more aware and concerned, market pressure on other growers to join the program would grow. Efforts to inform and involve the public could speed this transition, as outlined below.

Note that no new laws or government regulations are needed to implement this proposal – simply the interest and will of growers and conservationists, working collaboratively on a goal they both support. Note further that this model could easily spread internationally to other countries, particularly in Europe where the public is highly concerned about conservation. Furthermore, if this program were voluntarily implemented and successful, it could provide the basis for an effective Habitat Conservation Plan. Under an amendment to the original 1973 ESA, implementing a Habitat Conservation Plan provides an alternative that reduces the stringent provisions of the ESA, e.g., by allowing some "incidental take" of individuals as long as populations are secure. It is also possible to design and implement an HCP in advance of Listing, allowing the U.S. Fish & Wildlife Service to assign the species a lower level of protection (e.g., Threatened) or even to defer listing altogether.

Program to promote public participation

To ask the public to buy only plants which have the surcharge and tag, it will be important to inform them about certain key points including:

Why can't the flytrap just be preserved via cultivation?

The general public needs to understand propagating large numbers of potted Venus flytraps does nothing by itself to ensure the survival of the species. The only safe place for flytraps in the long run is in nature. Relying on cultivation would fail to preserve the flytrap for several reasons. First, the flytrap, like any other species, exists in an ecological and evolutionary context. If those contexts are lost, so is the species. Growing plants in cultivation in botanical gardens and hobbyist collections removes that context. Instead of natural selection, plants become subject to artificial selection favor-

ing plant genotypes that thrive under greenhouse conditions. Cultivated flytraps gradually resemble their wild counterparts less and less due to this inadvertent artificial selection.

Commercially grown flytraps may also become susceptible to disease including potential new pathogens which could quickly spread to infect most plants. In hobbyist collections, plants often die due to neglect or loss of interest. Botanic gardens change curators, plants get thrown out, and expertise can be lost. Finally, we cannot guarantee that propagated plants will persist. The next major recession or a war could quickly destabilize economies, trade, and society causing millions of plants to be lost.

Is listing the flytrap as federally endangered justified? Would its listing ensure that its populations are conserved?

Wild flytrap populations have declined greatly since the 1980s – for many reasons (Waller *et al.* 2016). These declines, coupled with its narrow geographic range and susceptibility to future habitat loss and encroachment, are the basis for the petition to list this species as Federally Endangered. Listing the Venus flytrap as endangered would trigger some protections including an analysis to designate critical habitat, possible funds for land acquisition, and efforts to manage and restore populations, e.g. using fires. While the Endangered Species Act has proved to be very effective at protecting and promoting the recovery of certain species (e.g., the bald eagle), it also has clear shortcomings, particularly for plants. These include the fact that Congress has historically underfunded endangered species programs, slowing how quickly they can be reviewed and listed and limiting funds for assessing and managing critical habitat for these species. Plants, in particular, wait very long times during the listing process and afterwards for these protections. Once a plant is listed as Endangered, it also typically receives only a small fraction of the staff time and budget that endangered mammals and birds receive. The Trump Administration severely cut funds to Endangered Species programs. Listings are now taking 6 years or more, slowing any federal assistance for this plant but also affording time to work together to institute the voluntary fee and generate a Habitat Conservation Plan. This makes more sense in any case than waiting for populations to decline further with only uncertain funds in the future.

It is also a surprise to many that endangered plants are not protected to the same degree as endangered animals. Anyone harming an endangered animal in any context is subject to stiff fines and penalties. In contrast, endangered plants growing on private lands gain no protection from exploitation (for reasons that go back to English Common Law). Thus, flytraps growing on private lands will not receive any protection even if they are listed (though trade in such plants would be restricted). Finally, the Endangered Species Act is a blunt instrument, requiring elaborate procedures that could interfere with trade even as on-the-ground management falters. Our shared goal here should be protecting wild populations.

Avoiding conflict over a Federal listing as Endangered.

The Endangered Species Act prohibits trade in listed species across state lines, even if they are ethically propagated. Thus, the ESA has the potential to shut down all commercial U.S. traffic in flytraps. The Lacey Act Amendment for plants does the same thing, making it a violation of the Amendment if the ESA is violated. Listing the flytrap as endangered in the U.S. could also trigger provisions in the international CITES treaty restricting international transport and trade in endangered species. To avoid these consequences, it would be best to foster co-operation between wholesale commercial growers and plant conservationists. Given their shared interests, it would behoove them to organize in advance of any formal listing of the flytrap as Federally Endangered.

They might also jointly hire attorneys to explore whether there may be a way to minimize impacts of a listing on commercial nurseries and sellers. It may also make sense to mobilize a campaign to inform growers of the situation, allow them to meet and discuss the situation, and invite them to contribute comments to the Federal Register.

A Nation-wide Campaign to save the Venus flytrap, as run by a non-profit conservation organization.

The surcharge we propose could provide immediate and substantial funds for protecting wild populations of the flytrap. In essence, the general public saves wild Venus flytrap populations by buying propagated and ethical plants. All that is needed is the will, a publicity campaign, and a fair mechanism to implement a structure (a committee of commercial nurserymen and plant conservationists) to oversee the program and spend the funds generated. The campaign is needed to publicize the plight of wild populations, raise awareness of how to save the flytrap, and encourage people to buy plants showing the tag with the surcharge.

A non-profit conservation organization might run the campaign. We are searching for one now.

This non-profit conservation organization, if it sponsored this campaign, might organize the approximately 81 commercial flytrap wholesale growers into a powerful political force in favor of protecting wild populations. I believe the most effective vehicle to do this is through 'Change.org" as a series of petitions to commercial wholesale growers along with an ad campaign directed towards the general public. It might also set up a hotline for commercial wholesale growers, hobbyists, the general public, and garden centers across the nation. The hotline would provide information on all aspects of the national-wide campaign. The phone number of this hotline might be placed prominently on the surcharge tag on each potted plant sold.

What you can do to help benefit wild populations in nature?

If you care about protecting the remaining wild Venus flytrap populations, you might:

1. Get the correct facts from those concerned with these efforts. Discern the truth to the best of your ability; both sides in this potential conflict are right and both sides are wrong.
2. Write your viewpoints in a Formal Comment to the Federal Register (federalregister.gov).
3. Request conflict resolution and co-operation if the conflict starts.
4. Share this article and information with commercial wholesale nurserymen who propagate the flytrap, garden centers which retail sale flytraps, online suppliers of flytraps for sale, and botanic gardens which exhibit flytraps. Schools sometimes exhibit flytraps to teach students and should be approached also with information.
5. Apply pressure on non-compliant growers by asking them how they feel about the situation and what they are doing to help save the flytrap.
6. Start a petition with "Change.org" to apply pressure on well-known outlets to voluntarily join this campaign. The petitions should emphasize the positive financial benefits of joining this campaign to protect the flytrap; companies should not be punished for selling ethically produced flytraps.
7. Help organize the campaign locally in your town or city by going to garden centers and botanic gardens and asking what they are willing to do for it.

Conclusion

Although almost everyone in the United States knows what the Venus flytrap looks like and how its snap-traps behave, very few have ever seen its pretty wetland savanna habitats covered with

thousands of plants displaying their red miniature bear-traps – a remarkable and awe-inspiring sight. It is worthwhile to engage those who grow the flytrap with great pleasure to become more familiar with the beauty of its disappearing habitats, its particular ecology that makes them dependent on these habitats, and their bleak fate as populations disappear, threatening this marvelous plant with extinction. For those who love nature and the flytrap, preserving wild populations and managing their habitats must become a priority. To protect these remarkable plants from harm, we must think beyond the fun of growing one or a few in a pot to invent a vehicle for saving these plants in nature. This will require growers, plant-loving hobbyists, and plant conservationists to think creatively and cooperate on programs that can work.

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The Florida flytrap mystery is solved

Jim Miller • Tallahassee • Florida 32308 • USA • jim_miller@mindspring.com

For many years, there has been much speculation as to how colonies of *Dionaea muscipula* — the Venus' Flytrap — appeared in the Florida Panhandle in Liberty County. Theories ranged from seed stuck to the feet of migrating birds to a former seller of "three bulbs for a dollar" flytraps planting them as a backup in case populations ran low in the Carolinas. Some even suggested they had been here all along, just undiscovered until more people began venturing into bogs and savannas in search of carnivorous plants.

At last we have the answer, and it is none of the above.

Considering the fact that I have been exploring locations throughout the southeast regularly since 1971, and how many people I have gotten to know over those nearly 50 years, I am actually shocked that it took this long to make the right connections and discover the person responsible for flytraps appearing in several areas in and around the Apalachicola Forest.

Not long ago I received an email from a person whom I will not name, as I do not have his permission to do so. In part, the message read:

> "You do not know me, but I am a CP grower as well. I read your Pinguicula article in CPN this month, and saw that you are from Tallahassee. I was born and grew up there for about 30 years and know the area quite well. My mother worked for the U.S. Forest Service…and we often explored the Apalachicola National Forest where I discovered acres and acres of Sarracenia. As a kid, I was taken by these plants and now I am 79 years old and still love them. I am not a seller, but just collect them because I love them. I now have a rather extensive collection of around 6000 plants (mostly two- and three-year-old seedlings) of Sarracenia that I have bred. I have about 40 registered cultivars.
>
> "...I retired in 2001. Since then I renewed my interest in carnivorous plants and now have 18 large outdoor beds where I grow Sarracenia.
>
> "In 1973 or 1974, I had collected quite a few Venus Flytrap seeds and returned to Tallahassee to visit my mother. I drove out (to areas) near Hosford and threw out my seeds in three different locations. Then forgot all about them. About 30 years later, I heard there were some flytrap colonies in that area and people were wondering how they got there. I don't know if mine survived, but I suspect some did. I met a grower friend here in NC who had gotten some flytraps from a friend in California, who had gotten them from 'the Hosford Bog.' He gave me some of those… plants, so now, maybe I have some of my plants from that original planting (decades) ago."

This account was confirmed for me by a person who lives in Tallahassee and knew of the seed being scattered in the early 1970s. A few other longtime Tallahassee residents may also well know this person from the short-lived Florida Carnivorous Plant Society. I was surprised I had never heard his name in all the years I have lived here, but we have exchanged emails several times. Mainly it's nice to finally have an answer as to the origin of the flytraps that grow about an hour from my doorstep!

Green Anole drinking nectar from *Sarracenia alata*

John Brueggen • St. Augustine • Florida • USA • JBrueggen@alligatorfarm.com

An online search will reveal publications of different species of anoles feeding on fruit and nectar. There are even some pet care guides that suggest giving nectar to pet Green Anoles (*Anolis carolinensis*). However, I was unable to locate anyone that has noted that Green Anoles drink nectar from plants of the genus *Sarracenia*.

I have seen tree frogs living inside *Sarracenia* pitcher plants in what appears to be a mutualistic relationship. Here is a video I captured of a Squirrel Frog (*Hyla squirella*) capturing a fly from inside a *Sarracenia leucophylla*: https://www.youtube.com/watch?v=hlGg2HIUdYA. While it may seem like the frog is stealing nutrients from the plant, the frog's feces in the plant more than makes up for it. I have witnessed Green Anoles on top of *Sarracenia* quite frequently, and even seen them grab flies that are attracted to the plants. I've seen the anoles down inside the plant, seemingly hunting just like the tree frog. However, I have also found anole skeletons inside the "stomach" of some of these pitcher plants. I guess they get stuck sometimes.

This spring, however, I witnessed a female Green Anole drinking the nectar from potted *Sarracenia alata*, a carnivorous pitcher plant from the southeastern United States (Fig. 1). She was so aggressive about it I was reminded of how Day Geckos in the genus *Phelsuma* lap up nectar: https://www.youtube.com/watch?v=1g_wus-U95o. Here is longer video of her drinking the nectar: https://youtu.be/5afitrbb3kc. While my deck, in northeast Florida, is not technically in the normal growing range of *S. alata*, the Green Anole's range does overlap with the natural range of these carnivorous pitcher plants in the wild. This is not the case of an anole drinking dew off of the plant. It was late afternoon and no dew was present. I have now seen the behavior on multiple occasions, but I believe that is has been the same lizard each time.

Figure 1: Female Green Anole drinking the nectar from potted *Sarracenia alata*.

A NOTE ON *DROSERA* SEED DISPERSAL

JASON KSEPKA • Farmingdale • New Jersey • USA • jasonksepka@gmail.com

During my explorations last summer of the Pinelands of southern New Jersey, I went to one of my favorite places. Unfortunately, this site is also a favorite place for off-road vehicles. The Forked River Mountains, and the adjacent powerline and railroad right-of-way, have been very severely damaged by illegal off-road vehicle use. In recent years, a number of volunteers organized, developed a plan, purchased and planted local white cedar trees in an effort to stabilize the soil and begin restoration of the site.

I noticed that *Drosera rotundifolia* and *D. intermedia* seemed to have segregated themselves to slightly different spaces in the same area (Fig. 1). The nature of the site allows for fluctuations in surface water level, the results of which can be seen in differences where the plants grew. Differences in seed morphology might possibly be the cause of the observed segregation.

Figure 1: Segregation of *Drosera intermedia* (foreground) and *D. rotundifolia* (background).

Drosera rotundifolia seeds have an elongated testa (Fig. 2). Like tiny sails, these seeds can float long distances and get deposited where the water splashes at the edges of a wetland or along any debris such as logs or sphagnum moss.

Drosera intermedia has an ovoid seed. Presumably this seed would be more likely to sink, or at least not move quite as far.

Differences in seed morphology might explain the pattern seen in Figure 1. It is possible that floating *D. rotundifolia* seed were deposited on the slightly higher and courser edge near the planted white cedars; whereas the ovoid *D. intermedia* seed is lower in the water and is deposited on the adjacent sand.

Figure 2: *Drosera intermedia* ovoid seeds (left) and *D. rotundifolia* with elongated testa (right).

It should be noted that the difference in size of the seeds and the distances we are talking about here, are small. In most locations, these two species are found growing next to one another. The texture of the landscape is so complicated that many factors must contribute to where the seed lands and germinates. But in this particular location, my guess is that seed morphology might explain the distribution of the plants.

A fascinating realm

Chris Kim • Leesburg • Georgia • USA • chrisjkim27@outlook.com

I am a junior in high school (2018-19 school year), and I currently grow about 19 varieties of carnivorous plants, which include 7 different genera. My first experience with insect-eating plants was in Kindergarten, when I saw a Venus flytrap in Walmart. I asked my mom for one. To my delight, we left the store that day with a carnivorous plant in our bag. Back at home, I put it by the windowsill and fed it flies that had died after getting trapped between the window pane and the mosquito netting. My family and I were fascinated by the moving plant, but I had no idea how to actually grow it. Unsurprisingly, the flytrap died. Nonetheless, this encounter with the flytrap was the closest I had gotten to the mysterious realm of carnivorous plants. Looking back, I can see that the experience foreshadowed the start of a long-term hobby.

I've had an interest in nature for a pretty long time. My childhood was filled with various attempts at growing or raising different animals and plants. I grew eggplants (*Solanum melongena)*, four o'clock (*Mirabilis jalapa)* flowers, and tried my hand at tulips among other plants. I kept water snails and *Triops* and went out to a nearby park with my sister to catch fireflies. At one point I was obsessed with earthworms and even ordered live worms through the mail and kept them for a time. Raising brine shrimp from their dried eggs was another interest for a while. These creatures from the creative mind of nature were enchanting. Plants that ate bugs, likewise, caught my eye. Even now, I think it's riveting that these plants, while technically producers, can also be included with consumers.

My second experience with carnivorous plants came in the form of the Dunecraft kit Carnivorous Creations right before I started 3rd grade. I followed the directions, and an eternity later, something sprouted. It was around that time that my family moved to southern Georgia. Without a better place I could think of, I put the newly germinated plants, with dome on, outside on a deck that gets direct sun all day. Unfortunately, they died. Now that I know more about growing plants, I think they may have gotten a bit too hot in the stagnant air of their plastic greenhouse placed in unforgiving full-day summer sun. Even with this failure, I became more interested in learning about these wondrous plants and headed to the public library. I devoured all the books in the children's section and was left wondering if there was something else. I decided to check out Peter D'Amato's *The Savage Garden*. I had already seen *The Savage Garden* in the catalog, but I had initially stayed away from it because I didn't know it was a book about growing carnivorous plants (my elementary school self didn't know what "cultivating" meant!). It was through the informative pages of *The Savage Garden* that I was properly introduced to the wonderful world of carnivorous plants.

I wanted to grow plants that were native to the southeastern U.S. as I didn't – and still don't – have a greenhouse or any other fancy equipment. I figured that native plants would grow best for me. After pouring through the different genera in Part III of *The Savage Garden*, I selected *Sarracenia leucophylla*, *Dionaea muscipula*, and *Drosera capensis* as my first plants (I know *D. capensis* is not native to the U.S. but it was said to be a great beginner's plant…). These plants were my 10th birthday gift. I ordered, of course, from California Carnivores, as that was the only specialty nursery I knew about then (from *The Savage Garden*). A few days later, I saw my first sundew and pitcher plant in person. Although I knew that *Sarracenia* and *Dionaea* are native to the southeastern U.S., I couldn't imagine what plant would enjoy the seemingly harsh conditions I observed outside. As a result of my caution, I didn't put my new plants outdoors. It's kind of funny now to think that I originally put the plants near a translucent bathroom window that only gets some sun in the morning. Of course, my sun-loving plants' conditions declined, and I put them outside as a last-ditch effort

to save them. I was surprised then to find how well carnivorous plants grew in the blinding sun and melting heat of my family's south-facing deck. After I figured out how to get these three plants to grow, I expanded into other species. Largely through various Christmases and birthdays, my collection grew. I originally only got more plants that were native to the southeast, such as other *Sarracenia*. However, I soon became adventurous and begin to diversify my collection in terms of the geographic origin of my plants. I got my first *Nepenthes*, *Nepenthes ventricosa*, in 2014. The plant really didn't do too well…until I thought to put it outside as well. Nowadays, I put all my *Nepenthes*, *N. ventricosa*, *N. boschiana*, and *N. sanguinea*, outside when night temperatures stay above about 10°C. In 2018, I expanded to try *Pinguicula*, *Cephalotus*, and tuberous *Drosera*.

Through the Internet, I found a new wealth of information outside of the library. Barry Rice's FAQ page, the ICPS website, and other sources on the Internet helped me to gain more information about carnivorous plants and how to grow them. I also found more books in the library catalog, such as Barry Rice's *Growing Carnivorous Plants* and Donald Schnell's *Carnivorous Plants of the United States and Canada* to supplement what I found online. I've also learned through experience. I remember the first time I transplanted *Sarracenia*, I was meticulous in getting the ratio of peat moss to sand exactly as stated in *The Savage Garden*. Now I just estimate how much sand or peat I need. At least for *Sarracenia*, I think anyone could grow them if they only follow three simple rules: blast them with as much sun as possible, give them low-mineral water and low nutrient soil, and allow them to be dormant in the winter. While many are easy to grow, I admit that some plants are tricky. My one attempt at growing *Drosophyllum* didn't work out…I think the humidity of southern Georgia doesn't suit *Drosophyllum* well.

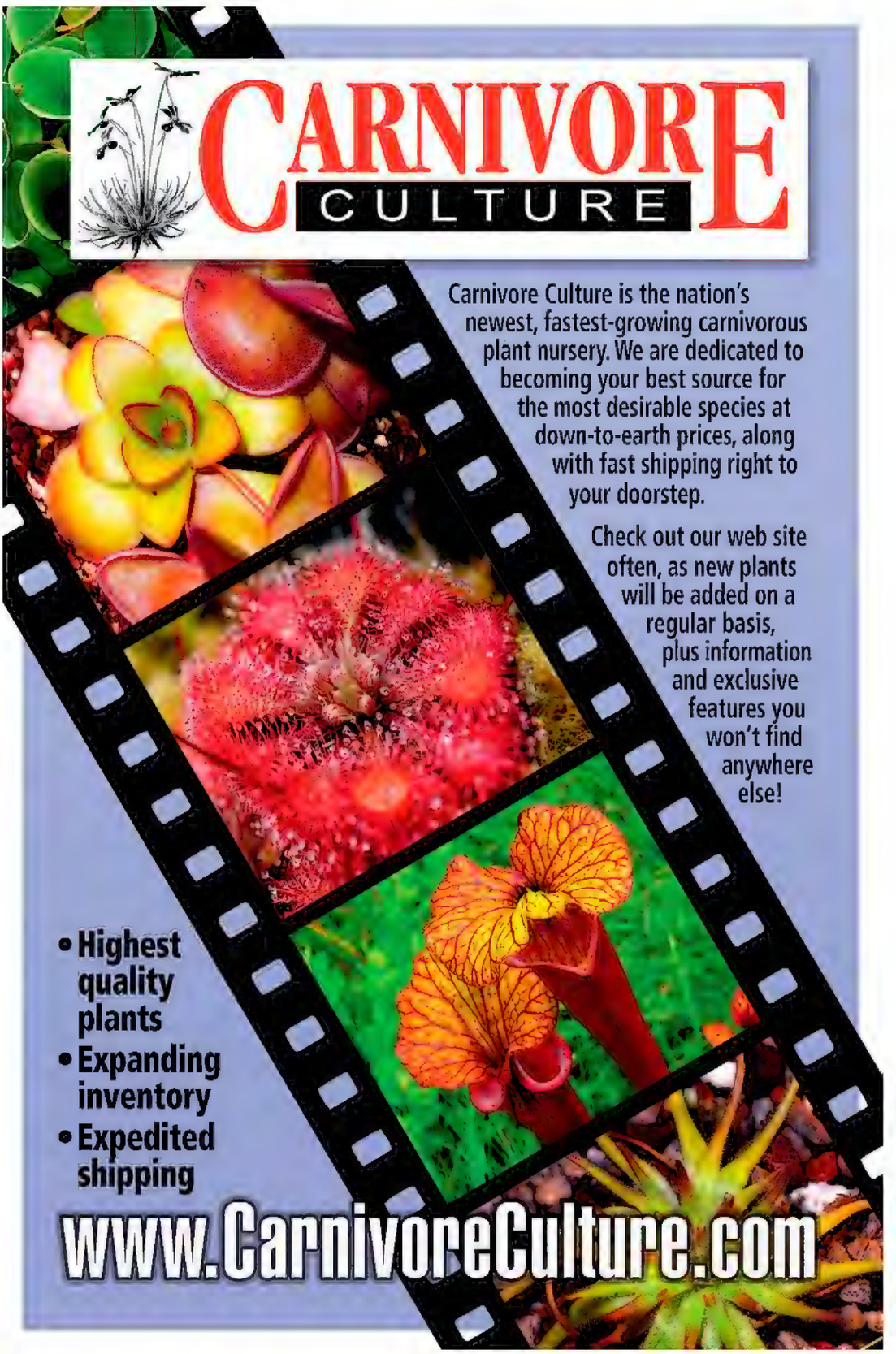
Other than the initial amazement at the rather odd nature of carnivorous plants, I've come to realize that these plants have much more to offer than just being insect-eating plants. As I have gotten older, I've also become fascinated by how exquisitely designed and beautiful these plants are. From the perfectly circular mouths of *Sarracenia flava* pitchers and beautifully blushed interiors of typical *Dionaea* plants, to the gem-like mucilage drops on *Drosera*, and the curious bristly traps of *Cephalotus*, the domain of carnivorous plants is one filled with thoughtful, sublime design. Carnivorous plants increase my appreciation of nature and make me wonder what else lies undiscovered in our cosmos.

Meat-eating plants even allowed me to introduce another interest to my grandmother when she visited this past summer. She already enjoyed plants to begin with, but was fascinated anew by carnivorous plants. I made sure to check out all the good carnivorous plant books from the library system I could find so she could look through them. I even cut open a *Sarracenia* pitcher to show her the waxy interior and the tiny downward pointing hairs (Fig. 1).

Figure 1: My grandmother studying a *Sarracenia* leaf.

Learning about carnivorous plants increased my knowledge about the world, if only a little. Other than gaining knowledge about the plants themselves, I learned a bit about world geography and climates. For example, I wouldn't know where the islands of Sumatra or Borneo are located if it weren't for the *Nepenthes* that lived there. I wouldn't know about the dry summer, wet winter climate of Western Australia if it weren't for the tuberous and pygmy *Drosera* that called that climate home.

I believe the world of carnivorous plants is one that anyone can appreciate and enjoy. Certainly, for me, these strange plants have become a constant presence in my life.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From nature to sculpture: an artist's journey

Pamela Tripp • Waveland, Mississippi & Baldwin, Michigan • USA • ptrippsimmons@gmail.com

I have always lived and worked near forests and water. My inspiration has always been drawn from nature.

I grew up and now maintain property in a county in Michigan that boasts 356 lakes and 46 trout streams. Almost half of the property in the county is state or federal recreation land.

From our log cabin in Michigan that my husband and I constructed in the 1980's (from cutting the trees to final trim), a creek is visible that flows from springs and eventually empties into the Pere Marquette, a national scenic river, several miles away. The roots of cedar, tamarack, white pine create a network of bridges through the bog along the creek. Growing along the stream are carpets of sphagnum moss and a diverse variety of plants, including the sundew *Drosera rotundifolia*. I recall picking wild cranberries in the bog near our home in Michigan and being extremely careful not to step on the pitcher plants, *Sarracenia purpurea*.

I have a BS in art from Grand Valley State University and have been doing art since then in one form or another. After graduation I held mostly seasonal jobs to allow myself time to do my art. I worked as forest fire fighter for the US Forest Service for several years, locally and participated in two fire campaigns in the western US. With my husband, I co-managed a 36-ha, 100-site, USFS campground adjacent to the Nordhouse Dunes Wilderness along the shore of Lake Michigan.

During and after working the campground life, I established and operated an art gallery to show my artwork and the pottery made by my husband, Dale Simmons. We also featured around 25 area and regional artists. After 25 years, we closed the gallery in 2017.

It was in 2001 we decided to split our time between Michigan and Mississippi. We found the beauty along the coast conducive to creating and selling our art. We purchased a fixer upper, made it livable and then Katrina hit. We were luckier than most, however. We lost most of the contents of our home because of flooding due to the unprecedented surge. We were able to clean, paint, repair, and replace. It was during this time that in order to escape the devastation, we would take drives north, in the countryside, away from the hurricane zone. During one of these excursions we found an area where hundreds of yellow trumpet pitcher plants (*Sarracenia alata*) grew along the highway. It was such a bright sight contrasted with the horrible devastation on the coast.

Living part time on the Mississippi coast, we have discovered several locations where carnivorous plants thrive. Another favorite species, I have yet to create, is the candy stripe quality of the white-top pitcher plant (*Sarracenia leucophylla*). We found these along the Clear Creek Trail near Milton, Florida. The Crosby Arboretum in Picayune, Mississippi is another great spot to find pitcher plants. The Dead Tiger Creek Savanna has two species of pitcher plants and their hybrids.

Several years ago, I began crafting 3D forms of my watercolor paintings. Among the many images I have used, carnivorous plants offer the most interesting of forms. In addition to my own paintings and 3D creations, I design and apply the imagery on my husband's wheel thrown raku pottery. These images include pitcher plants, sundew, jack-in-pulpit, and a variety of other designs.

I begin each sculpture by making a form. It is fashioned either from paper mache, paper clay, or stiff card stock. Once I have the form created, I cut up reproductions of previous paintings I have done and cover the form using the technique of decoupage. I will either take complete parts of the reproduction or take random pieces that match the local color of what it is I am covering. The result will not be exact, but a suggestion. I add components that may or not be growing alongside the main plant or form. For example, to suggest sphagnum moss, I painted sweet gum balls. Sometimes the

Figure 1: Assembling components for paper sculptures, Jack in the Pulpit and Yellow Water Lilies (left); wheel thrown Raku vase by Dale Simmons with pitcher plant design and application by Pamela Tripp (right).

Figure 2: "*Sarracenia purpurea*", approximately 33 × 23 cm, original designs on printed paper, paper mache, sweet gum balls, and Masonite (left); "*Sarracenia alata*" approximately 33 × 23 cm, original designs on printed paper, paper mache, and Masonite (right).

leaf shapes I add are funky designs that would never be found in nature, but give the idea that it does when adjacent to the main form.

I am always looking for unusual plants that have textures or forms that would translate in paper form in an interesting way. I am not concerned with a photographic representation but more with creating an artistic interpretation, leaving the imagination to fill in the blanks.

Review of recent taxonomic literature

Annotated by Jan Schlauer • Zwischenstr. 11 • D-60594 Frankfurt/Main • Germany • jan@carnivorousplants.org

The latest version of the nomenclatural Code (ICN, Shenzhen 2018, https://www.iapt-taxon.org/nomen/main.php) allows for the description of almost everything as a new species by almost everyone. The result is a bewildering explosion of new names in the literature that makes taxonomy a challenging enterprise for specialists (and a hopeless hermetism for interested laypersons) at a worrying pace. 836 more or less widely accepted names for carnivorous plants have been published until 2018 (Fleischmann *et al.*, Species of carnivorous plants, in: Ellison, A.M., and Adamec, L. (eds.): Carnivorous Plants: Physiology, Ecology, and Evolution, Oxford University Press, 2018, pp. 411-433). With 265 years of Linnaean nomenclature this corresponds to a mean rate of three acceptable, new names per year. Subsequent to that publication and to the end of the same year, no less than 28 additional carnivorous plant taxa at species rank or below have been proposed. The appraisal below is not an effort to dam this deluge in (a futile exercise unless the afflux will be limited) but rather an admonition: If the present nomenclatural inflation continues (and there is nothing to indicate otherwise), this will pose a serious threat not only to the science that struggles to understand biodiversity but also to any effort to conserve it. We have to deal with more and more names that mean less and less, losing perspective and targets for directed action. How should the current loss of biodiversity be explained to the people who should spend time and resources for conservation if all they see is an accelerating increase of apparent species numbers?

Drosera huegelii var. *phillmanniana* Y.-A.Utz & R.P.Gibson, Carniv. Pl. Newslett. 46(4): 134, 2017
SW Western Australia

Apparently confined to the Stirling Range, this is a montane taxon (above 800 m alt.) that differs from the typical variety in having a shorter stem.

Drosera × *californica* var. *arenaria* B.Rice, Drosera World Vol. 2: 1034, 2017
Florida, USA

A hybrid between *D. filiformis* var. *tracyi* and *D. filiformis* var. *floridana* and intermediate in external appearance.

Drosera filiformis var. *floridana* B.Rice, Drosera World Vol. 2: 998, 2017
Florida, USA

Distinguished from *D. filiformis* var. *filiformis* (that does apparently not occur in Florida) by broader leaves, thicker scapes and larger flowers.

Drosera gunniana (Planch.) de Salas, Muelleria 36: 92, 2018
Eastern Australia and Tasmania

Basionym: *Drosera peltata* var. *gunniana* Planch., another difficult to delimit Australian member of the polymorphic and widespread "*D. peltata* complex". Apparently closest to *D. hookeri* but usually larger, with pink or red (not white) tubers and denser and slightly longer sepal hairs.

Drosera albonotata A.S.Rob., A.T.Cross, Meisterl & A.Fleischm., Phytotaxa 346(3): 223, 2018
SW Western Australia

Formerly included in *D. miniata*, this is the only orange-flowered pygmy sundew with pandurate petals. *D. walyunga*, a close relative sharing the same general range and pandurate petals, has pink flowers.

Drosera xerophila A.Fleischm., Willdenowia 48(1): 94, 2018
Cape, South Africa

Another member of the *D. cuneifolia* alliance (incl. *D. admirabilis* and *D. esterhuyseniae*), characterized by cuneate leaves with tentacles confined to the distal half (*D. esterhuyseniae* has oblong leaves, *D. admirabilis* and *D. cuneifolia* have tentacles across the whole leaf surface). The borderline to *D. aliciae* (and its splitoffs, all with more intensely divided styles) thus becomes even more diffuse.

An alternative view is to regard all taxa mentioned above except *D. cuneifolia* s.str. (with three, only basally bifid style arms) as members of the *D. aliciae* alliance, which would draw the borderline closer to *D. cuneifolia*.

Nepenthes biak Jebb & Cheek, Blumea 62: 175, 2018
New Guinea, Indonesia

A segregate from *N. insignis* (with further ones already being announced) characterized by tubular pitchers that are slightly constricted above the base (vs. funnel-shaped without constriction in *N. insignis*).

Nepenthes adrianii J.Batoro & A.Wartono, Indian Journal of Plant Sciences 6(1): 14, 2017
Java, Indonesia

Related to *N. gymnamphora* but differs by 1-flowered pedicels (usually 2-flowered in *N. gymnamphora*), larger and wider pitchers with a broader peristome; has been identified with *N. spathulata* from S Sumatra by some observers.

Nepenthes alfredoi V.B.Amoroso & Lagunday, Philipp. J. Syst. Biol. 11(2): 15, 2018
Mindanao, Philippines

Another splitoff in the "*N. alata* group", compared to *N. zygon* and *N. mindanaoensis* (NB: the latter is not closely related to *N. alata*!) in the original description and predominantly characterized by fringed pitcher wings that descend down the tendril, a feature said to be otherwise unknown in the group.

Nepenthes malimumuensis Lagunday, Acma, Cabana, Sabas & V.B.Amoroso, Philippine Journal of Science 146(2): 160, 2017
Mindanao, Philippines

Compared to *N. sumagaya* (probably a later synonym of *N. copelandii*, which is not very similar to *N. malimumuensis*) in the original description and said to differ by more reduced pitcher wings, more longitudinal leaf nerves and more reduced lid appendages.

Nepenthes manobo Lagunday, Acma, Cabana, Sabas & V.B.Amoroso, Philippine Journal of Science 146(2): 161, 2017
Mindanao, Philippines

Compared to "*N. surigaoensis*" (a confused name, the type of which belongs to *N. merrilliana*) in the original description and said to differ by less decurrent petiole wings, upper pitchers with a distinct hip, more orbicular lid and shorter peristome teeth.

Sarracenia rubra subsp. *viatorum* B.Rice, Carniv. Pl. Newslett. 47(4): 154, 2018
Georgia & South Carolina, USA

Similar to *Sarracenia rubra* subsp. *gulfensis* but differs primarily in smaller pitcher size, a lid that is more gaping or slanted upwards, and densely pubescent pitcher exteriors.

Pinguicula olmeca Zamudio, Burelo & González-Aguilar, Botanical Sciences 96(2): 360, 2018
Tabasco, Mexico

Closely related to the polymorphic and widespread *P. moranensis* but differs by homophyllous growth (no "winter" rosette with reduced leaves is formed) and by a very long (4-6 cm) corolla spur.

Pinguicula australandina Gluch, Carniv. Pl. Newslett. 46(4): 123, 2017
Andes of Chile and Argentina

(Not only) the author thinks the type specimen of *P. chilensis* (from coastal, lowland Valdivia) belongs to *P. antarctica* and describes *P. australandina* to coin a name for most plants (from high Andean, inland Chile and Argentina) that have been called "*P. chilensis*" before. (but cf. Roccia, Carniv. Pl. Newslett. 47(2): 44-46, 2018).

Pinguicula nahuelbutensis Gluch, Carniv. Pl. Newslett. 46(4): 127, 2017
Araucania, Chile

Closely related to *P. antarctica* (and to *P. australandina*) but differs from both by an even shorter pedicel, from *P. antarctica* by a more isolobate corolla (upper lip shorter than lower in *P. antarctica*), and from *P. australandina* by a shorter spur.

Pinguicula casperi H.D.Juárez & Zamudio, Phytoneuron 2018-14: 11, 2018
Durango, Mexico

Closely related to *P. parvifolia* but differs by fewer (up to 50 instead of 60-80) "winter" leaves, broader "summer" leaves, and triangular to ovate-triangular instead of oblong-lanceolate calyx lobes that are accrescent in fruit (not accrescent in *P. parvifolia*).

Pinguicula michoacana Zamudio & H.D.Juárez, Phytoneuron 2018-14: 16, 2018
Michoacan, Mexico

Closely related to *P. oblongiloba* but differs by fewer (up to 40 instead of 60-86) "winter" leaves and by glabrous (not ciliate) petioles.

Pinguicula robertiana Zamudio & Hern.Rend., Phytoneuron 2018-14: 2, 2018
San Luis Potosi, Mexico

Closely related to *P. heterophylla* but differs by fewer (up to 20 instead of ca. 100) "winter" leaves that do not form an underground bulb, a clearly bilabiate (not isolobate) corolla with a slightly longer spur.

Pinguicula rzedowskiana Zamudio & H.D.Juárez, Phytoneuron 2018-14: 6, 2018
Queretaro, Mexico

Closely related to *P. calderoniae* but differs by "winter" leaves that do not form an underground bulb, flowering while the "winter" rosette is still present (*P. calderoniae* flowers while the "summer" rosette is developed).

Pinguicula zamudioana H.D.Juárez & Muñiz-Castro, Phytotaxa 372(4): 245, 2018
Jalisco, Mexico

Closely related to *P. oblongiloba* (and *P. michoacana*, its recent segregate) but differs by homophyllous growth with a single type of ("summer") leaves, leaves with glabrous (not ciliate) petioles, shorter pedicels, and triangular–lanceolate (instead of lanceolate) calyx lobes.

Pinguicula saetabensis M.B.Crespo, Mart.-Azorín & M.A.Alonso, Plant Biosystems 153(1): 79, 2019 (electronic pre-publication in 2018 was not valid, as no pagination was available then)
SE Spain

Closely related to *P. mundi* but differs by longer, erect summer leaves approaching the condition in *P. vallisneriifolia*. The aberrant population from the Sierra de Segura (cf. Schlauer, Carniv. Pl. Newslett. 46(4): 156, 2017) comes to mind in this respect. Further study may provide additional insight.

Utricularia sunilii Naveen Kum. & K.M.P.Kumar, Phytotaxa 371(2): 140, 2018
Kerala, India

This plant has obviously malformed flowers (with additional lateral lobes on the lower corolla lip), otherwise there is no obvious difference to *U. polygaloides* (incl. *U. babui*).

Utricularia biceps Gonella & Baleeiro, Phytotaxa 376(5): 215, 2018
Minas Gerais, Brazil

Similar to *Utricularia tricolor* but distinguished by the corolla lower lip with a prominent bilobed crest with tuberculate texture on the palate, a spur with swollen bifid apex, the upper lip of the stigma with ciliate apex, and ovoid seeds. As already indicated by Taylor (Utricularia - a Taxonomic Monograph, 1989), any number of taxa could be (and have been) defined in the highly polymorphic and widespread *U. amethystina* alliance (*Utricularia* sect. *Foliosa* - 3 species with almost 50 synonyms!) based on criteria such as those mentioned above.

Utricularia albertiana R.W.Jobson & Baleeiro, Telopea 21: 58, 2018
Kimberleys, Western Australia

Differs from *U. dunstaniae* (with which it was identified by Taylor, l.c.) in having spur apex rounded/obtuse, central corolla lower lip lobe longer than the spur, calyx lower lip almost as long as the spur, and trap dorsal appendage usually present (but not so in the figure that accompanies the description and that only shows the lateral appendages that are occasionally also present in *U. dunstaniae*), doubtfully sufficient to split an otherwise well circumscribed, distinctive species.

Utricularia bidentata R.W.Jobson & Baleeiro, Telopea 21: 59, 2018
Northern Australia

Closely related to *U. kimberleyensis* (with which it was identified by Taylor, l.c.) but differs in having two white, prominently raised central ridges at the base of the lower corolla lip that are longer than the two outer ridges, and a peduncle that is sparsely papillose (vs. occasionally shortly hispid) towards the base.

Utricularia hamata R.W.Jobson & M.D.Barrett, Telopea 21: 65, 2018
Kimberleys, Western Australia

Related to *U. hamiltonii* (that is apparently confined to the Northern Territory) but differs in having bifid lateral trap appendages, a white corolla, lobes of upper lip limb rounded, corolla lower lip limb obovate, spur broadly conical, curved upwards with apex yellow.

Utricularia magna R.W.Jobson & M.D.Barrett, Telopea 21: 68, 2018
Kimberleys, Western Australia

Similar to *U. tridactyla* but differs in having a light-mauve corolla, a shallowly 3-lobed corolla lower lip, corolla upper lip superior part obovate, bladder-traps usually to c. 7.2 mm (rarely to 10 mm) long. Morphology strongly indicates *U. magna* is rather a synonym (or the closest relative) of *U. arnhemica* from the Northern Territory although genetic data do apparently not support this.

Utricularia papilliscapa R.W.Jobson & M.D.Barrett, Telopea 21: 71, 2018
Kimberleys, Western Australia

Related to *U. tridactyla* but differs in having peduncles that are densely papillose at the base, a light pink corolla with a more shallowly 3-lobed lower lip and an upper lip with its superior part oblong and acutely bifid. Doubtfully distinct.

Utricularia limmenensis R.W.Jobson, Telopea 21: 74, 2018
Northern Territory, Australia

Similar to *U. albiflora* from Queensland but differs in having a pale violet corolla, a narrow upper lip limb slightly constricted near middle, corolla lower lip limb three-lobed, and spur 1.3–2 times longer than lower lip. The similar *U. linearis* (likewise from the Northern Territory, with white, not pale violet flowers that have a less pronounced palate and a slightly shorter spur) is not mentioned at all.

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